MARCH 7, 1960

THREADING—NEW
TWIST FOR SOLIDS

missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

TEST EDITION OF M/R ASTROLOG

itus report on U.S. missiles, rockets
d space vehicles—and all satellites . . 15

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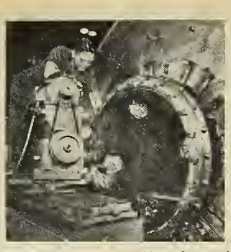
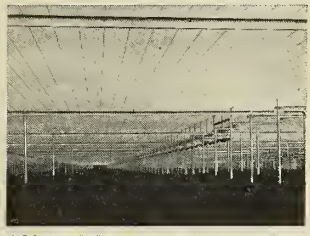


COVER: Merz Engineering's giant thread mill cuts buttress threads in large solid motor case aft closure. This development in technology generated a series of new machine designs. See report on p. 36.

M/R'S ASTROLOG goes into its fourth bimonthly edition with this issue. For the latest report in this unique series, incorporating recent changes, turn to p. 15.



ANTENNA array of Space Surveillance Receiver is 1600 ft. long, 300 ft. wide. An article on ARPA's "dark satellite" detection system—and the interservice rivalry over it—begins on p. 21.

ON SITE at Vandenberg AFB now are this and two other Convair *Atlas* ICBM's in "coffin" type launchers, bringing to six the total on launchers at the base. A report with first photographs starts on p. 34.

missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

30,100 copies this issue

NEW TRAIL SENSE FOR PILOTS ON THE PROWL

The horizon is always clear for the F-105 Thunderchief with NASARR... the compact, lightweight monopulse radar system designed and built by Autonetics. NASARR gives the Republic Thunderchief an uncanny sixth sense for air-to-air search, automatic tracking, air-to-ground ranging, ground mapping, and terrain avoidance—regardless of height, speed, attitude, or visibility. For more than a decade Autonetics has pioneered the way with monopulse radar systems like NASARR to give America's pilots the keenest trail sense possible.

Armament Control Systems by Autonetics

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Washington Countdown

IN THE PENTAGON

Dyna-Soar is delayed again . . .
by another technical study ordered by the Administration. The study is holding up new funding of the Air Force program which is aimed at eventual development of a Space bomber.

• • •

Meantime, Mrs. V . . .
the ARPA study program on maneuverable space vehicles, has moved to the Air Force. It has been incorporated in the *Dyna-Soar* program.

• • •

More mobile air defense . . .
is now planned by the Army. R&D work to make Western Electric's *Nike-Hercules* a mobile field unit is already underway.

• • •

Some new names . . .
worth keeping in mind:

. . . Project 3059—the Air Force code name given to feasibility studies on a 1-million-to-2-million-pound-thrust solid rocket motor.

. . . Notsnik—the nickname given to Navy R&D satellites launched from aircraft at the Navy Ordnance Test Station.

• • •

Project Orion is moving . . .
from ARPA to the Air Force. However, the project—aimed at development of a controlled nuclear-blast rocket—faces a dead end unless the moratorium on nuclear testing is lifted.

• • •

Missile shopping lists . . .
for Army hardware—in volume, of course—are now carrying these approximate prices:

. . . Convair *Redeyes*—$6500 each.

. . . Emerson *Little Johns*—$8000 each.

. . . Jet Propulsion Laboratory/Sperry *Sergeants*—$405,000 each.

. . . Douglas *Honest Johns*—$25,000 each including warheads.

. . . *Davy Crocketts*—$1400 each.

• • •

A better *Bullpup* . . .
—the old White Lance project—is being planned by the Navy for the Air Force. Thiokol has a $2-million contract to develop a new *Bullpup* engine expected to double the Martin air-to-surface missile's 4 to 8 mile range. The engine—a pre-packaged liquid—is called Guardian III. The missile will be nuclear tipped.

AT NASA

Test Pilot Joe Walker . . .
will be the first to fly the North American *X-15* recently turned over to the Air Force and NASA. Plans called for a first flight by about March 20, but there may be a delay. Rodgers Dry Lake near Edwards AFB may not be firm enough for landing because of rains.

• • •

Launching of *Thor-Able IV* . . .
and its payload bound for Venus' orbit has been definitely scheduled between March 8-11. If the long-delayed shot is successful, the payload will be named *Pioneer V*.

• • •

No TV scanner . . .
will be carried by *Thor-Able IV* as previously planned. STL removed it because the payload will not pass close enough to anything to photograph.

INTERNATIONAL

Seven Soviet missile cruisers . . .
are reported by the Swedish Navy to be operating out of Baltic ports. The Red ships are reported to be armed with short-range surface-to-surface missiles and what appear to be large liquid-propelled missiles.

• • •

Japanese *Nike-Ajax* sites . . .
are to be located at Keihin, Nagoya, Kelhanshin and Kammon. Four *Nike-Hercules* sites are planned for cities on Honshu. *Hawk* battalions also are planned to be stationed at Keihin.

• • •

A British 'flying telescope' . . .
will be launched in a *Skylark* research rocket from Australia's Woomera Test Range. The rocket payload—developed by a London University research group—will transmit pictures to earth from an altitude of about 100 miles.

• • •

Japanese space scientists . . .
are planning to visit the United States to discuss a U.S.-Japanese program of space exploration. U.S. boosters probably would be used to launch Japanese payloads for some projects.

He put a new twist in an old trick

His problem was to take a 3"x6"x 3-foot piece of wave guide tubing made of .08-inch thick aluminum and to twist one end 90° to the other *without buckling or stretching any part of it...so that a cross section taken anywhere along its length remained a perfect rectangle.*

The standard solution for a problem like this: Support the tube internally with a solder-like substance that's melted in, cooled, melted out after twisting. It won't work here because the mass of the substance is too great.

Here's how this AMF production engineer found the answer. First, he visualized the concept that, in any symmetrical twist, *the center axis never moves.* Then he applied this concept by stringing a metal rod through the center of 288 rectangular shims, inserted them in the tube, cushioned them with the same solder-like substance. Jaws clamp on either end. One of them rotates *slowly* (twisting time: over 2 minutes) giving the metal time to flow. The result: Perfect twists, every time.

Single Command Concept

This bit of production know-how is a sample of the ingenuity AMF brings to every assignment.

AMF people are organized in a *single operational unit* offering a wide range of engineering and production capabilities. Its purpose: to accept assignments at any stage from concept through development production, and service training.. and to complete them faster...in

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In engineering and manufacturing AMF has ingenuity you can use... **AMERICAN MACHINE & FOUNDRY COMP.**

Industry Countdown

MANUFACTURING

Major shift in nose cone . . .
configuration for ICBM's to resemble that of *Polaris* may be in the making. Sharp-eyed observers note Avco re-entry vehicle aboard a recent *Titan* was almost identical to the blunt, tubular *Polaris* model, which is a heat-sink type.

• • •

One-a-week *Titan* . . .
test flights are about to start at Cape Canaveral in a big push to make up time lost during series of failures last year.

• • •

Concrete is being poured . . .
at three of nine new single *Atlas* sites, which will be dispersed in a 60-mile radius of Cheyenne, Wyo. The launchers—all "Hollywood hard" flush with the ground—comprise the third *Atlas* ICBM squadron going in at Warren AFB.

• • •

North American is in on . . .
the formation of a new French company—Dynatom. The co-partners, Societé Alsacienne de Constructions Mecaniques and Chantiers de L'Atlantique, had a major role in developing France's first A-bomb and are expected to work on the development of nuclear warheads for missiles.

• • •

Nord is rolling . . .
on an order for 600 *SS-10* and *SS-11* antitank missiles for Japan. Delivery is scheduled before the end of this year.

• • •

Piping of TV missile . . .
courses from Huntsville to West Point, MIT and the Royal Canadian Military Academy, Kingston, Ont., will start April 7. Students will view the closed-circuit courses on 20 by 12 ft. screens in their classrooms.

PROPULSION

Pre-tensioned, moulded . . .
fibre and resin solid-rocket motor cases up to 60 in. id and 30 ft. in length reportedly can be fabricated under new process patented by National Associates Inc. The cases would have a tensile strength of up to 200,000 psi.

• • •

Blimp transport . . .
of space boosters too big to be moved on the ground (a Goodyear proposal) still interests NASA. But the big hitch is in developing a blimp with high load capacity. *Saturn* is being transported on a barge from Huntsville to the Cape because it's cheaper. NASA, incidentally, has run calculations to determine whether *Saturn* would float if it were filled with hydrogen. It won't.

ASTRIONICS

Plastic radar reflectors . . .
for shipboard Navy *Tartar* missiles being produced by Republic under a Raytheon contract reportedly weigh 325 lbs. and can take shock loads up to 160,000 lbs. They are said to have greater strength-to-size ratio than any previous plastic reflectors made and to operate in winds up to 100 knots.

• • •

Big drive is on . . .
to standardize test procedures for electromagnetic relays. Major step toward removing this obstacle to component qualification was taken recently at a meeting of the American Standards Association and the National Association of Relay Manufacturers in Los Angeles.

• • •

Builders of structures . . .
in space may rightly be called "astrotects." But, if they are on the moon, says Prof. Goettelman, Dean of Architecture at Catholic University, they will no doubt be called "lunatects."

WE HEAR THAT

Britain's defense minister . . .
Harold Watkinson, will arrive in the U.S. shortly to investigate the possibility of buying the *Skybolt* ALBM and the *Polaris* FBM. The British are keenly interested in mobile systems as a replacement for their fixed, land-based *Thor* IRBM's . . . RCA's Harry R. Wege is predicting the United States will require a 75% increase in its engineer force in the next 10 years . . . Successful rocket sled tests of the Autonetic guidance for *Minuteman* may cut down the number of developmental test firings of the missile . . . Temple High Temperature Research Institute's Dr. Aristed V. Grosse suggests changing millions of dollars to "mollars" and billions of dollars to "bollars." Shortening up these incomprehensible figures, he says, would save DOD mollars.

...AND BRISTOL SIDDELE

Bristol Siddeley Engines Limited produce the Thor ramjet. Two Thors power the missile in the Bristol/Ferranti Bloodhound guided weapon system. This system forms the most effective defence against air attack at very low, up to very high altitudes. And the great flexibility and development potential of the ramjet ensure that Bloodhound will be able to intercept any attacking aircraft for many years to come.

Bloodhound is the RAF's ground-to-air missile system and has been ordered by Sweden and Australia.

The ramjet is the simplest air-breathing engine that has ever been devised and the Thor is virtually a stainless steel tube which can be lifted by two men. A thrust of over 20,000 lb at Mach 3 can be expected from a typical ramjet of the Thor's size.

At speeds of Mach 2.5 and upwards, the ramjet has a lower specific fuel consumption and a lighter weight than any other prime mover, and the higher the speed the greater its efficiency. It is the most efficient powerplant for long-range flight at high supersonic speeds within the earth's atmosphere.

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Defense study finds . . .

Future ICBM's Look Unstoppable

Twelve-company program sponsored by ARPA finds science today has no answers

by James A. Fusca

NEW YORK—Results of a search for effective methods of defending the United States against attack by the sophisticated ballistic missiles of 1970-80 era—including investigation of such esoteric weapons as antigravity, antimatter, and the so-called "death rays" of science fiction—indicate that no promising approach exists within the bounds of present-day scientific knowledge.

Ballistic missiles of the '70's probably will be capable of altering their trajectories in flight to change their points of re-entry and targets. They are expected to have nose cones able to glide and maneuver within the atmosphere, and to be equipped with decoys to be sent out in clouds to confuse antimissile defense systems.

The 12-company study program that has investigated these problems, called GLIPAR for Guide Line Identification Program for Antimissile Research, has been conducted under the sponsorship of the Advanced Research Projects Agency. The final report of a nine-month program which ended last month is now being edited and will probably be published next month.

The GLIPAR program is part of ARPA's Project *Defender*, under which the agency conducts research and development leading to advanced capabilities in ballistic missile defense. GLIPAR, however, has been aimed at setting out initial guide lines for research to develop such a capability for the period between 1970 and 1980.

In the course of the GLIPAR program, a large number of potentially applicable physical mechanisms have been studied with the objective of identifying and assigning a relative value of the mechanisms with the maximum defense potential. The conclusion reached in the final report is that no approach investigated appears promising, the great majority are rated as hopeless, and a few are considered to be worthy of further study because of the lack of present knowledge.

The wide variety of physical mechanisms studied were grouped for convenience into classes, although frequently one approach might overlap into several categories. In general, these classes are:

• **Fields**—In this class are included gravitational, magnetic, magnetohydrodynamic, and nuclear fields. Also included is antigravity, defined for the purposes of the GLIPAR program as any mechanism modifying existing gravitational fields. The study analyzed the effects of these fields both on a re-entry body and on its contained warhead.

• **Plasmas**—Plasmas, or largely ionized hot gases, were studied from several points of view. A hot plasma might cook a re-entry body; the plasma would be capable of transmitting magnetohydrodynamic waves; while passage through these magnetic fields might induce eddy currents in the re-entry body that would cause heating, plus generating mechanical forces that might cause dynamic instability.

Another effect that was examined within this classification was ball lightning, usually associated with thunderstorms. Ball lightning has been proposed as a general weapon both here and in the Soviet Union, but on a scientific basis does not appear to have very much potential.

• **Solid material impact**—Within this class the orbiting of large numbers of solid particles was studied, ranging in size from grains of sand which might erode the missile nose cone and cause it to overheat to objects with enough inertia to cause direct physical damage.

One problem of this approach is that this pellet screen would affect the launching of friendly missiles; another, and more important, problem is that the Soviet Union could blast a hole in the screen over its own territory and drop missiles through this hole while it is over the United States.

• **Particle beams**—Under this classification the effects of beams of protons, electrons, neutrons, and gamma rays were studied. Also included in this group were antimatter beams, including antiprotons, anti-electrons and anti-neutrons.

• **Optical beams**—These beams divide on the basis of frequency into infrared, visible, and ultraviolet. Neither infrared nor visible light beams appear to have any promise, while not enough is known about the ultraviolet part of the spectrum.

• **Radio frequency beams**—One of the unknowns in attempting to heat a re-entry body by means of a powerful beam of radio energy is the interaction of the electromagnetic energy with the plasma sheath generated around the body during re-entry.

• **Cold gases**—One method of employing cold, or low kinetic energy, gases would be to poison the atmosphere where a nose cone will re-enter with a highly re-active chemical such as hydrogen fluoride. This would have no effect, however, if the nose cone was coated with a non-reactive plastic.

Another method of defense considered was the use of combinations of two or more different techniques. If one defense mechanism was easily countermeasured, the second technique might be selected to take advantage of the countermeasure system. At present, no combination of two defensive techniques that will produce this result has been found, but future studies may be expected to examine three or more defense approaches used in combination.

One of the more unusual approaches proposed as part of GLIPAR was the detonation of very-large-yield hydrogen weapons above an incoming missile along its flight trajectory to irradiate it with large doses of X-rays. Neglecting casualties over a period of time from fallout, estimates of the instantaneous casualties due to ultraviolet radiation made by other scientists on the GLIPAR program range up to and over 10% of the country's total population.

Program Organization

Phase I part of the GLIPAR program, which has taken nine months and cost about $1.6 million, was divided

---

The GLIPAR program has been directed by Dr. Ward Low of the Ballistic Missile Defense Branch of ARPA's institute for Defense Analyses. Contractors on the program have been:

Radio Corp. of America's Defense Electronics Products Div.
University of Chicago's Laboratories for Applied Sciences
General Mills, Mechanical Div.
Thompson Ramo Wooldridge, Inc.
Technical Operations, Inc.
Republic Aviation Corp., Missile Systems Div.
Aeronutronic Div., Ford Motor Co.
Allied Research Associates, Inc.
Hughes Aircraft Co.
General Electric's Defense Electronics Div.
Convair Div. of General Dynamics
Industrial Research Associates, Inc.

into two periods. During the first seven months the 12 contractors conducted individual studies in their own laboratories and wrote a report on the results.

For the last two months of the program, January and February of this year, the contractors have provided representatives to a study meeting at the Presidio in San Francisco. During the first month the individual results were examined and compared, and a first draft of a final report prepared. These representatives then spent a week at their home laboratory, where the assembled results were examined by all project personnel. The remainder of the last month was spent in a final evaluation of program results and a second drafting of the final report.

On the basis of the results of Phase I, ARPA officials doubt that a Phase II follow-on of the program will be required. Their opinion is that the original purpose of the program—discovering those directions in which future research may possibly yield some return—has been fulfilled.

GAD Says NASA Withheld F-1 Capsule Contract Data

The Rocketdyne Division of North American Aviation negotiated a 6½% fixed fee of $6,254,145 to develop the nation's first F-1 single-chamber 1.5-million-lb.-thrust rocket booster for an estimated $96,217,616.

McDonnell Aircraft Corp. negotiated a 6.28% fixed fee of $1,150,000 on an estimated cost of $18,300,000 to develop the Project *Mercury* space capsule.

The fixed fees were disclosed last week in General Accounting Office reports to the House Space Committee, in which GAO complained that in both contracts NASA refused to surrender to GAO recommendations of its Source Selection Boards for audit. NASA, it was revealed in hearings held during January, invoked its executive privilege on grounds that the Board recommendations were merely personal judgments of subordinates.

NASA Administrator Dr. T. Keith Glennan testified that he had established a policy of personally deciding the award of all contracts over $1 million. (Contracts under that amount are awarded on the decision of the Source Selection Board.)

• **Tempered criticism**—GAO insisted that the NASA cloak of secrecy hampered its audit, but the Congressional "watchdog" agency said that the procedures followed by NASA in evaluating the cost substantiation submitted by Rocketdyne were "satisfactory." GAO also conceded that the money estimates also may not have been the significant factor in the winning proposal. Seven bidders were invited to the Oct. 14, 1958, contract briefing, and all but one—Bell Aircraft—submitted proposals.

GAO said that Aerojet-General proposed four programs. Its "Program A" estimate was $98,627,490 with a fixed 7% fee of $6,900,000. The other program estimates were progressively higher, according to GAO. A-G estimates included facility modifications, as did Rocketdyne's.

General Electric proposed a four-phase program and estimated a separate cost for each phase. The total was $190,010,900, with a proposed 8% fee of $15,200,700. Pratt & Whitney Div. of United Aircraft, GAO reported, submitted detailed cost for three development programs, which called for construction of test stands. Including a 7% fixed fee, P&W summarized its proposals as: $61,972,321, the 3½-year program; $105,354,678, the 4½-year program, and $89,354,678, the 5½-year program.

The GAO report said, "Reaction Motors stated in its proposal that its in-house facilities were not adequate for the development of all the components of the proposed engine, and that it had, therefore, arranged to subcontract injector and thrust chamber fabrication to the Convair Division of General Dynamics Corp., San Diego, and to the Solar Aircraft Co., San Diego, and to subcontract the fabrication and initial testing of the turbopump to the Allison Div. of General Motors . . ." Exclusive of propellants, Reaction offered a proposal of $179,674,474, with a fixed 9% fee totaling $16,170,692. Total estimated cost, including propellants and fixed fee, would be $211,-136,387.

Wright Aeronautical Division of Curtiss-Wright Corp. submitted a proposal for development of a "liquid turborocket engine" which would use a liquid oxygen hydrocarbon fuel and would develop nominal thrust of 1 million lbs. at sea level. The firm, GAO said, proposed construction of new development and test facilities. "Curtiss-Wright proposed that the Government construct the liquid oxygen plant and that the relative portion of the remaining costs to be borne by the Government and C-W be determined by negotiation," said GAO. Estimated cost of facilities was $52- to $55-million; and exclusive of these, the C-W bid, with propellants and a fixed 7% fee would be $92,270,516.

• **'Parallel procedure'**—In a separate report, GAO said the "procedure followed in selecting the successful proposal for the Project *Mercury* capsule parallels the principle and procedure used in selecting the successful proposal for development of the 1-million-lb.-thrust rocket engine." The agency said it believed the Source Selection Board data was needed to conduct a proper review. But it wrote that "documents in the contract file indicate that the contracting officer made proper use of the services available to him in determining the reasonableness of the McDonnell estimate of the reimbursable cost; that those elements of the cost estimated which were based upon the contractor's cost experience were reviewed at the McDonnell plant, that those elements of the cost estimated which were based upon engineering estimates of the requirements of the program were reviewed by technical personnel of NASA, and that questions raised as the result of those reviews were satisfactorily resolved."

—news briefs—

• **Cape Canaveral**—The Air Force postponed a 9000-mile *Atlas* shot into the southern Indian Ocean on March 1. There was no official explanation, but there were reports that the launch was called off at least temporarily because of possible international political implications.

• **Washington**—NASA created a new Office of Life Sciences and named Dr. Clark T. Randt to head it. The new office—described by NASA as "a fifth major division"—covers the fields of biology, medicine and psychology.

• **London**—Britain is understood to have decided to add mobile missile launchers to its missile arsenal. British defense officials are believed to be interested in possible adoption of the Lockheed *Polaris* and the Douglas *Skybolt*.

• **Helsinki**—A tremendous explosion is reported to have blasted a Soviet ICBM base near Alakkrtti close to the Russo-Finnish border. Sources said they believed the blast was a nuclear explosion.

• **Washington**—The House Science and Astronautics Committee last week approved the $915 million FY '61 budget authorization request for NASA in total informing the space agency that it could ask for more later in the year if necessary. The bill will be brought to the floor of the House March 7. Early passage is expected.

Weaponry Lesson: 2 Yrs. for *Pershing*

First flight for 'crash program' bird successful; longer shot due shortly

by Heather MacKinnon

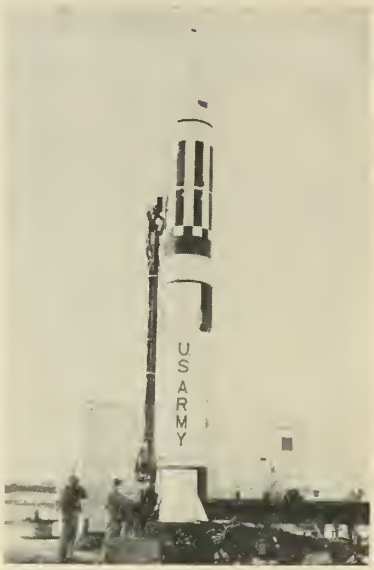
Less than two years after the initial contract was announced, The Martin Co.'s *Pershing* was successfully fired Feb. 25 in its first free-flight test by the U.S. Army.

Shot from its combination transporter-launcher at Cape Canaveral, the two-stage MRBM traveled a programed 30 miles down the Atlantic Missile Range. Although total capability is estimated to be about 500 miles, the Army test vehicle carried a dummy second stage and was not separated. Later tests will add refinements, more detailed objectives and longer ranges, in accordance with the Army "progressive firing objectives."

Cloaked in mystery, the solid-propellant bird has the highest priority of any missile in the Army program, and represents a $200-million investment. An additional $118 million in the FY '60 budget is earmarked for continued research and development by Martin.

Pershing was developed by Martin with only technical supervision of the Army Ballistic Missile Agency to replace *Redstone,* which has been deployed with overseas troops since 1958. It is designed to have a short reaction time, versatility in all types of terrain and climate, and be lighter, smaller and even more mobile than its predecessor.

• **Description**—Although little has been officially made public, it is generally recognized that the missile is about 40 feet long, 24 inches in diameter and solid-propelled. Thiokol Chemical Corp. at Huntsville, Ala., designed and developed the two-stage propulsion system. Fuzing and arming of the nuclear warhead is subcontracted to Bulova Watch Co.



PERSHING and "TEL," its unique transporter-erector-launcher, are easily transported and maneuvered by ground troops.

Bendix Eclipse-Pioneer Division has received the subcontract for an inertial guidance stable platform and associated equipment, which will eliminate the possibility of outside jamming. The system is reported to be similar to those used in *Redstone* and *Jupiter.*

• **New transporter-launcher**—*Pershing* will have a "shoot and scoot" capability, thanks to a unique transporter-erector-launcher (TEL) built by Thompson Ramo-Wooldridge, Inc. With four wheels and pneumatic tires, the vehicle can be towed across rough terrain and easily maneuvered into firing position.

During transport, the missile is carried in a horizontal position on the dual track erector. When ready to fire, the launching platform mounted at the rear of the vehicle rotates to the ground and is leveled, the erector raises to the vertical position, and the missile is placed on the launcher. When the erector returns to a horizontal position, the missile is in place in a vertical position on the azimuth ring of the launcher. The azimuth position is then adjusted and checked and the bird is ready to go—all within a few minutes.

A cable mast mounted in a bracket attached to the launcher azimuth ring at one end and engaged with electrical and air connections in the missile at the other, contains control cables, air ducts and high-pressure air lines.

After these lines are used to precondition, checkout and fire, the cable is automatically disconnected from the missile, and held in a near-vertical position by a brake. With this feature, the cable is prevented from falling or being destroyed during firing, and thus can be used again.

Countdown and launch activity is accomplished from a tracked vehicle transported fire control hut, where test and checkout equipment also is housed.

The entire system is transportable by either helicopter or aircraft.

Bullpup ASM Getting Nuclear Warhead

Bullpup is getting some teeth—a nuclear warhead to be developed under a new $4.5-million AF contract, according to Martin spokesmen. The new warhead will be interchangeable with the conventional one to be used in *GAM-83B,* an advanced model.

In addition, a new electronics control package has been developed for both *GAM-83A* and *GAM-83B,* permitting the launching of the missile from planes while they are flying parallel to the target, making a dive unnecessary. Studies also are under way for an improved guidance system to be incorporated into *GAM-83B.*

Bullpup was first developed as an air-to-surface missile *(ASM-N-7)* by Martin-Orlando for the Navy and is operational with the Fleet. *GAM-83A* grew out of the Navy version.

M/R Opens New York News Bureau

MISSILES AND ROCKETS *has expanded its news and technical coverage in the New York and New England areas with the opening of a new editorial bureau in New York City under the direction of James A. Fusca.*

M/R's four previously established bureaus are in Los Angeles, Geneva, Paris and London.

Prior to joining M/R, Fusca was an electronics editor for Aviation Week. Earlier, he was an engineer with Reeves Instrument Corp., Melpar, Inc., and RCA. He was also a supervisor of government research projects with Radiation Research Corp., and served as Technical Advisor for the Military Assistance Advisory Group of the U.S. Embassy in Brussels. A graduate engineer of Columbia University, Fusca is a member of IRE and the American Rocket Society and serves on two committees on radio navigation for the Radio Technical Commission for Aeronautics.

The new editorial office is at 20 East 46th Street, New York 17, N.Y. Telephone number is Yukon 6-3900.

Missiles and Rockets

ASTROLOG

A status report on U.S. missiles and rockets and all space vehicles presently in orbit

★ *Indicates change since January 4 edition*

PROJECT	CONTRACTORS	DESCRIPTION	STATUS
SPACE VEHICLES			
★AGENA (Air Force)	Lockheed, prime; Bell, propulsion	1700-pound satellite after burnout	Used in DISCOVERER program; larger model to be used with ATLAS and THOR under development; NASA also will use to take place of cancelled VEGA
★ATLAS-ABLE (NASA)	STL, prime; GE/Burroughs, Arma, guidance; Rocketdyne, Aerojet-General, ABL, propulsion	Orbit 200-lb. vehicle around moon or send into deep space	Two lunar orbit attempts this spring and summer
★CENTAUR (NASA)	Convair, prime; Pratt & Whitney/JPL, propulsion	Soft-land 730-lb. on moon; first liquid hydrogen engine; 30,000-lbs. of thrust	First test flight in spring, 1961
COURIER (ARPA-Army)	Army Signal Corps, prime	Delayed repeater communications satellite	R&D; satellite in advanced stage; first to be launched in spring
DECREE (ARPA)	No contract announced	24-hour instantaneous repeater satellite	R&D
★DISCOVERER (Air Force)	Lockheed, prime; GE, re-entry vehicle	THOR-AGENA launchings of early stabilized satellites	Of first 10 launched, 5 stabilized in orbit; ejected capsules not recovered
DYNA-SOAR I (Air Force)	Boeing, space craft and systems integrator; Martin, propulsion	Boost-glide orbital space craft; first space bomber; TITAN booster	R&D; first glider flights from Edwards AFB by 1962
★ECHO (NASA)	Langley Research Center, prime	Puts 100 ft. inflatable sphere in 1000 mile orbit; passive communication satellite	First launch this spring
JUNO II (NASA)	ABMA/Chrysler, prime; Ford Instrument, guid.; Rocketdyne/JPL, prop.	Early deep space booster; small payload	Five more shots planned
★MERCURY (NASA)	NASA, prime; McDonnell, capsule	First manned satellite	Capsule tests on ATLAS to begin; manned capsule launching by REDSTONE down Atlantic this Summer; first manned flight scheduled in 1961
★MIDAS (Air Force)	Lockheed, prime	Early-warning satellite; detect ICBM launchings by infrared before birds leave pad; R&D models weigh 2 tons; operational system to have 12-15 satellites	R&D; early launchings from Cape; later from Pacific Missile Range's Point Arguello; transferred from ARPA to Air Force; first R&D launching Feb. 26 failed because of apparent trouble in second stage
MRS. V. (Air Force)	No contract announced	Manueverable, recoverable space vehicle; also known as DYNA-SOAR II	Turned over to Air Force as part of Dyna-Soar program.
★NOVA (NASA)	No prime announced; Rocketdyne, propulsion	Clustered 6-9 million lb. booster plus upper stages	Early R&D on 1.5 million lb. F-1 engines
★ORION (ARPA-Air Force)	General Atomic	Space station launched by series of atomic explosions	Advanced engineering studies under way; tests may be attempted; program to be shifted to Air Force alone
PROJECT 3059	No contracts announced	Solid motor in 1 million to 2 million lb. thrust class	Research aimed at determining feasibility

PROJECT	CONTRACTORS	DESCRIPTION	STATUS
★SAMOS (Air Force)	Lockheed, prime	Reconnaissance satellite; formerly SENTRY	R&D; stabilization already achieved in DISCOVERER series; first test launching scheduled this spring; transferred from ARPA to Air Force
★SATURN (NASA)	NASA Huntsville Facility, prime; Rocketdyne, Pratt & Whitney, propulsion; others not announced	Five-stage vehicle with 1.5-million-lb. clustered booster. Second stage to be cluster of four 200,000-lb. liquid hydrogen engines; third, two 200-K engines; fourth, four 20-K's; fifth, two 20-K's	New timetable: first static firing this month; first flight late 1961; first operational flight 1963 with 4th and 5th stages on booster
★SCOUT (NASA-Air Force)	Chance Vought, prime; Minneapolis-Honeywell, guidance; Aerojet-General/Allegany/Thiokol, propulsion	Solid four-stage satellite launcher; 200-300 lb. payload in orbit	Operational this summer; Air Force and probably Navy also to use for research
STEER (ARPA)	GE-Bendix, prime	Polar-orbiting instantaneous repeater satellite	R&D
TACKLE (ARPA)	No contract announced	Polar orbiting communications satellite	R&D
★THOR-ABLE (NASA)	STL, prime; Rocketdyne/Aerojet-General/ABL, propulsion	Early deep space booster	Sun orbit shot in Spring—nine months behind schedule. Only two shots left in program
★THOR-DELTA (NASA)	STL, prime; IT&T, guidance; Rocketdyne/Aerojet-General/Allegany,prop.	Put 65-lb. satellite in orbit around moon	R&D; first flight early this year; to be used in ECHO and TIROS program
★TIROS (NASA-AF-Army-Navy-Wea. Bu.)	RCA-Army Signal Corps, prime	Meteorological satellite; TV pictures of cloud cover	R&D; three launchings this spring; international politics stalling program
★TRANSIT (ARPA-Navy)	Johns Hopkins Laboratory, prime	Navigational satellite; R&D model weighs more than 250 lbs.; operational model about 50 lbs.	First shot almost complete failure because final stage didn't operate; second shot slipped to March
TRIBE (ARPA)		Family of space launching vehicles	Planning
★YO YO (Navy)	No contract announced	Tactical sea-launched one-pass reconnaissance satelloid	Studies
★X-15 (NASA-AF-Navy)	North American, prime; Thiokol, propulsion	Rocket plane; 3600 mph; flight at edge of space; on AF model each XLR-11 rocket engines develop 16,000 lbs. of thrust; later XLR-99 engines to develop 50,000 lbs.	Five powered flights; one plane damaged in landing; second plane hit Mach 2 and more than 80,000 ft Feb. 11; first X-15 has been accepted by the Air Force, turned over to NASA for testing at Edwards AFB

MISSILES & ROCKETS

ABLE (Navy)	Avco, prime	ASW surface-to-underwater; 500 lb. solid; conventional	Deployed on destroyer escorts
ASROC (Navy)	Minneapolis-Honeywell, prime	Surface-to-underwater; solid rocket torpedo; nuclear	R&D; operational Jan. 1961
ASTOR (Navy)	Westinghouse, prime	ASW underwater to underwater; rocket torpedo; nuclear	R&D
★ATLAS (Air Force)	Convair, prime; GE/Burroughs, Arma, guidance; Rocketdyne, propulsion; GE, re-entry vehicle	ICBM; more than 5500-mile range; liquid; nuclear	41 military launchings: 25 successes, 8 partial, 8 failures; 4 scientific launchings; 4 successes. Two operational at Vandenburg; 11 of 13 sites named
AUTOMET (Army)	No contract announced	New solid tactical missile	R&D; test vehicle stage
★ARM (Air Force)	No contract announced	Anti-radar missile	R&D
★BOMARC-A (Air Force)	Boeing, prime; Westinghcuse, guidance; Marquardt, propulsion	Ramjet surface-to-air interceptor; liquid booster; 200 m. range; Mach 2.7; nuclear	First squadron operational at McGuire AFB, N.J.
BOMARC-B (Air Force)	Boeing, prime; Westinghouse, guidance; Thiokol, propulsion	Ramjet, surface-to-air; solid booster; Mach 2.7; more than 500 m. range; nuclear	Late development stage
★BULLPUP (Navy-Air Force)	Martin, prime; Republic, guidance; Thiokol (Reaction motors), propulsion	Air-to-surface; 4-8 mile range; conventional 250-lb. bomb; new model has pre-packaged liquid; nuclear-tipped model under development	Deployed with Atlantic and Pacific Fleets; bigger model under R&D; Air Force buying modified version
COBRA (Navy)	No contract announced	Anti-ship radar missile	Early R&D

PROJECT	CONTRACTORS	DESCRIPTION	STATUS
COBRA (Marines)	Boelkow Entwicklungen, West Germany, prime; Daystrom, U.S. distributor	24.6-pound anti-tank missile; 1 mile range; 191 mph speed; solid propellant	Marines evaluating for purchase; already operational with West German troops
CORPORAL (Army)	Firestone, prime; Gilfillan, guidance; Ryan, propulsion	Surface-to-surface; 75-mile range; liquid; nuclear	Deployed with U.S. & NATO troops in Europe
CORVUS (Navy)	Temco, prime; W. L. Maxson guidance; Reaction Motors, propulsion	Air-to-surface; pre-packaged liquid; radar homing; about 100-miles range	First successful test July 18, 1959
CLAYMORE (Army)	No contract announced	Anti-personnel missile	R&D
CROW (Navy)	No contract announced	Air-to-air missile	R&D; has been flight tested
*DAVY CROCKETT (Army)	In-house project at Rock Island, Ill., arsenal	Surface-to-surface; solid; bazooka launched; sub-kiloton nuclear warhead	R&D; operational in FY '61
EAGLE (Navy)	Bendix, prime; Sanders, guidance; Aerojet propulsion	Air-to-air; 100-mile range; nuclear; for launching from relatively-slow aircraft	Early R&D
FALCON (Air Force)	Hughes, prime; Hughes, guidance; Thiokol, propulsion	Air-to-air; 5-mile range; Mach 2; solid; conventional	GAR-1D & GAR-2A & GAR-3 operational; GAR-4 & GAR-9 under R&D; GAR-9 work slowed
GENIE (Air Force)	Douglas, prime; Aerojet-General, propulsion	Air-to-air; unguided; 1.5-mile range; nuclear	Operational
GIMLET (Navy)	No contract announced	Air-to-surface; unguided; considered highly accurate	R&D
*HAWK (Army)	Raytheon, prime; Raytheon, guidance; Aerojet-Ganaral, propulsion	Surface-to-air; 20-mile range; solid; conventional; designed to hit low-flying planes	Operational; units training for early deployment to Europe and Far East; advanced Hawk under development; Jan. 29 successfully intercepted Honest John, first known intercept of one tactical missile by another.
HONEST JOHN (Army)	Douglas, prime; Hercules, propulsion	Surface-to-surface; unguided; 16.5-mile range; nuclear	Operational; deployed in Europe
*HOUND DOG (Air Force)	North American, prime; Autonetics, guidance; Pratt and Whitney, propulsion	Air-breathing air-to-surface; 500-mile range; Mach 1.7; turbojet; nuclear	Operational; to be launched from B-52G intercontinental bombers; stockpile expected to exceed 400; training fully underway
*JUPITER (Army)	Chrysler, prime; Ford Instrument, guidance; Rocketdyne, propulsion; Goodyear, reentry vehicle	IRBM; liquid; nuclear	To be deployed with Italian troops in Italy and used as AICBM target drone; 29 military launchings: 22 successes; 5 partials; 2 failures. One 15-bird squadron to be deployed in Turkey. Last R&D test shot launched Feb. 4
*LACROSSE (Army)	Martin, prime; Federal Telecommunications Laboratories, guidance; Thiokol, propulsion	Surface-to-surface; highly mobile; 20-mile range; solid; nuclear	Operational; 4 units being trained; 3 more planned for 1960; to be deployed in Europe and Far East; advanced LACROSSE R&D program dropped at least temporarily
LITTLE JOHN (Army)	Emerson Electric, prime; ABL, propulsion	Surface-to-surface; unguided; 10-mile range; solid; nuclear	Operational this year; units training with it
LOBBER (Army)	No contract announced	Surface-to-surface; cargo carrier; 10-15 mile range; also can drop napalm	Studies
LULU (Navy)	No contract announced	Surface-to-surface; nuclear	R&D
*MACE (Air Force)	Martin, prime; AC Spark Plug, guidance; Allison, propulsion	Air-breathing surface-to-surface; more than 650-mile range; turbojet & solid; nuclear; B model has 1000-m. range	Being deployed with U.S. troops in West Germany; now all mobile but hard-base version in R&D
MATADOR (Air Force)	Martin, prime; Thiokol/Allison, propulsion	Air-breathing surface-to-surface; 650-mile range	Being turned over to West Germans; also deployed in Far East
MAULER (Army)	Convair; prime	Surface-to-air; IR guidance; field weapon	R&D
*MINUTEMAN (Air Force)	Boeing, major contractor; Autonetics, guidance; Thiokol, propulsion first stage; Aerojet, propulsion second stage; Avco, re-entry vehicle; AMF, rail launcher	2nd generation ICBM; solid; mobile; nuclear; 3 stages	R&D. Expected to be operational by late 1962 and deployed in 1963; to be installed in hardened sites and made mobile on trains, possibly trucks; five tethered full-scale test models successfully fired from silos

PROJECT	CONTRACTORS	DESCRIPTION	STATUS
★MISSILE A (Army)	ARGMA to act as prime; six R&D contracts for components scheduled to be let soon	Surface-to-surface; 65-70 mile range; solid	Design studies
NIKE-AJAX (Army)	Western Electric, prime; Western Electric, guidance; Hercules Powder, propulsion	Surface-to-air; 25-mile range; Mach 2.5; solid & liquid; conventional	Deployed in U.S., Europe & Far East
NIKE-HERCULES (Army)	Western Electric, prime; Western Electric, guidance; Hercules & Thiokol, propulsion	Surface-to-air; 80-mile range; Mach 3+; nuclear; claimed effective against air-launched air-breathing missiles	Rapidly replacing NIKE-AJAX
★NIKE-ZEUS (Army)	Western Electric, prime; Bell Telephone, guidance; Thiokol and Grand Central, propulsion	Anti-missile; 3-stage; 200-mile range; solid; nuclear	R&D test launchings at White Sands at the rate of about one a month beginning Aug. 26. Four launchings: 3 successful, 1 partial. Test shots in the Pacific against drone missiles planned in mid-1961. Administration has refused to okay Army recommendation to begin production.
★PERSHING (Army)	Martin, prime; Bendix, guidance; Thiokol, propulsion	Surface-to-surface; solid; under 700-mile range; nuclear	R&D; to replace REDSTONE; first R&D launching Feb. 25 from Cape a success; 35 miles as programmed
★POLARIS (Navy)	Lockheed, prime; GE, guidance and fire control; Aerojet-General, propulsion; Lockheed, re-entry vehicle	Underwater and surface-to-surface; solid; 1200-mile range can hit more than 90% all targets in Russia; nuclear	52 launchings of test vehicle; 35 successes; 15 partial; 2 failures; launched from surface ship Aug. 27, 1959; expected operational late in 1960; fully guided 900-m. range vehicles under test at Cape Canaveral
RAVEN (Navy)	No contract announced	Air-to-surface; about 500-mile range	Study
REDEYE (Army)	Convair, prime; Atlantic Research, propulsion	Surface-to-air; 20-lb. bazooka-type; IR guidance; solid; conventional	R&D
REDSTONE (Army)	Chrysler, prime; Ford Instrument, guidance; Rocketdyne, propulsion	Surface-to-surface; liquid; 200-mile range; nuclear	Deployed with U.S. troops in Europe
REGULUS II (Navy)	Chance Vought, prime; Stavid, guidance; Aerojet-General, propulsion	Surface-to-surface; turbojet & solid; 500-mile range; nuclear	Deployed aboard U.S. submarines; used as target drone
SERGEANT (Army)	JPL/Sperry, prime; Sperry, guidance; Thiokol, propulsion	Surface-to-surface; solid; more than 75-mile range; nuclear	Production. To replace CORPORAL this year
SHILLELAGH (Army)	Aeronutronics, prime	Surface-to-surface; lightweight; can be vehicle-mounted	R&D; expected to be operational mid-1960's
SIDEWINDER (Navy)	GE-Philco, prime; Avion, guidance; Naval Powder Plant, propulsion	Air-to-air; IR guidance; 6-7-mile range; conventional	Deployed with Navy and Air Force; all-weather type under development
★SKYBOLT (Air Force)	Douglas, prime; Nortronics, guidance; Aerojet, propulsion	Air launched ballistic missile; more than 1000-mile range; solid; nuclear	R&D contract let
SLAM (Air Force)	No contract announced	Surface-to-surface; low-altitude; supersonic; nuclear-powered ramjet; nuclear	Study-R&D
SNARK (Air Force)	Norair, prime; Northrop, guidance; Aerojet-General, propulsion	Surface-to-surface; 5500-mile range; solid and turbojet; Mach .9; nuclear	Deployed at Presque Isle, Maine
★SPARROW III (Navy)	Raytheon, prime; Raytheon, guidance; Aerojet-General, Thiokol, propulsion	Air-to-air; 5-8-mile range; Mach 2.5-3; solid and pre-packaged liquid; conventional	Operational with carrier aircraft; earlier SPARROW I obsolete; new contract aimed at extending range and altitude
SUBROC (Navy)	Goodyear, prime; Kearfott, guidance; Thiokol, propulsion	Underwater or surface-to-underwater; 25-50 mile range; solid; nuclear	R&D
SUPER TALOS (Navy)	No contract announced	Seagoing anti-missile missile; possible AICBM	Early R&D
SS-10 (Army)	Nord Aviation, prime	Surface-to-surface; primarily anti-tank; 1600-yards range; 33 lbs. solid; wire guided; conventional	Operationel with U.S., French and other NATO and Western units; battle-tested in North Africa
SS-11 (Army)	Nord Aviation, prime	Surface-to-surface; also helicopter-to-surface; 3800-yard range; 63 lbs.; wire guided; conventional	Operational. Under evaluation by Army.
TALOS (Navy)	Bendix, prime; Farnsworth/Sperry, guidance; Bendix/McDonnell, propulsion	Surface-to-surface; 65-mile range; solid & ramjet; Mach 2.5; nucleer	Operational aboard cruiser Galveston

PROJECT	CONTRACTORS	DESCRIPTION	STATUS
TARTAR (Navy)	Convair, prime; Raytheon, guidance; Aerojet-General, propulsion	Surface-to-air; 10-mile range; Mach 2; 15 feet long & 1 foot in diameter; solid dual-thrust motor; conventional	Many test firings in Pacific; expected deployment 1960 as primary armament of guided missile destroyers; production
TERRIER (Navy)	Convair, prime; Reeves/FTL, Sperry, guidance; ABL, propulsion	Surface-to-air; 10-mile range; Mach 2.5; 27 feet long; solid; conventional	Operational with fleet
★TERRIER-ADVANCED (Navy)	Convair, prime; Reeves/FTL, Sperry, guidance; ABL, propulsion	About 100% performance improvement over TERRIER	Operational Advanced TERRIERS to be deployed about mid-1960
★THOR (Air Force)	Douglas, prime; AC Spark Plug, guidance; Rocketdyne, propulsion; GE, reentry vehicle	Surface-to-surface IRBM; 1500-mile range; liquid; nuclear	Operational; 4 bases set up in England. 61 military launchings: 42 successes; 11 partial; 8 failures; 24 scientific launchings; 19 successful, 3 partial; 2 failures; R&D and "hot rod" advanced tests completed Feb. 29.
★TITAN (Air Force)	Martin, prime; Bell, Remington Rand, guidance; Aerojet-General, propulsion; Avco, re-entry vehicle	Surface-to-surface ICBM; 5500-mile range; liquid; 90 feet long; nuclear	9 launchings test vehicles: 6 successes; 3 failures; program slipping
WAGTAIL (Air Force)	Minneapolis-Honeywell, prime	Air-to-ground; low-level; solid; designed to climb over hills and trees	R&D
ZUNI (Navy)	Naval Ordnance Test Station, prime	Air-to-air, air-to-surface; solid; unguided rocket; 5-mile range; conventional	Operational

SATELLITES

SATELLITE	COUNTRY	STATUS
EXPLORER I (30.8 lbs.)	U.S.	Launched 1/31/58, est. life 3-5 years. Orbits earth, perigee: 224 m., apogee: 1573 m., period 114.8 min. (Discovered Van Allen Belt)
VANGUARD I (3.25 lbs.)	U.S.	Launched 3/17/58, est. life 200-1000 years. Orbits earth, perigee: 409 m., apogee: 2453 m.
★SPUTNIK III (about 3.5 tons)	Russia	Launched 5/15/58, est. life, 11 mo. Orbits earth, perigee: 135 m., apogee: 1167, period: 106 min., inclination to equator: 65.3°. Speed, at perigee: 18,837, at apogee: 14,637 mph.
LUNIK I "MECHTA" (3245 lbs.)	Russia	Launched 1/2/59. Believed to be in orbit around sun on 15 mo. cycle.
VANGUARD II (20.7 lbs.)	U.S.	Launched 2/17/59, est. life 10 years +. Orbits earth but is "wobbling," perigee: 347 m., apogee: 2064, period: 125.85 min., inclination to equator: 32.88°.
PIONEER IV (13.40 lbs.)	U.S.	Launched 3/3/59. Orbits sun, and achieved primary mission, an Earth-Moon trajectory.
★EXPLORER VI "PADDLE-WHEEL" (142 lbs.)	U.S.	Launched 8/7/59, est. life: to Aug. 1961. Orbits earth, perigee: 156 m., apogee: 26,357 m., period: 12½ hours, speed: at perigee 23,031, at apogee: 3126 mph., inclination to equator: 46.9°.
VANGUARD III (about 100 lbs.)	U.S.	Launched 9/18/59, est. life 30-40 years. Orbits earth, perigee: 319 m., apogee: 2329 m.
LUNIK III (about 614 lbs.)	Russia	Launched 10/4/59, est. long life, orbits earth-moon; took first picture far side of moon; est. perigee: 30,000 m., apogee: 291,000 m.
EXPLORER VII (91.5 lbs.)	U.S.	Launched 10/13/59, est. life 20 years, orbits earth, perigee: 341, apogee: 679.
★DISCOVERER V CAPSULE (less than 300 lbs.)	U.S.	Launched 8/13/59. Satellite burned up in atmosphere Sept. 28. Capsule also thought to have been destroyed, but it was later rediscovered and first thought to be an unidentified Soviet satellite. Est. life several months. perigee: 134, apogee: 1074.
★DISCOVERER VIII	U.S.	Launched 11/20/59, est. life 2-3 months, perigee: 116, apogee: 913.

Reprints Available

Since MISSILES AND ROCKETS MAGAZINE first started giving a bimonthly report on the status of space vehicles and missiles and rockets, numerous readers have asked about the availability of reprints.

The following charges are established:

1 to 100 copies—20¢ each
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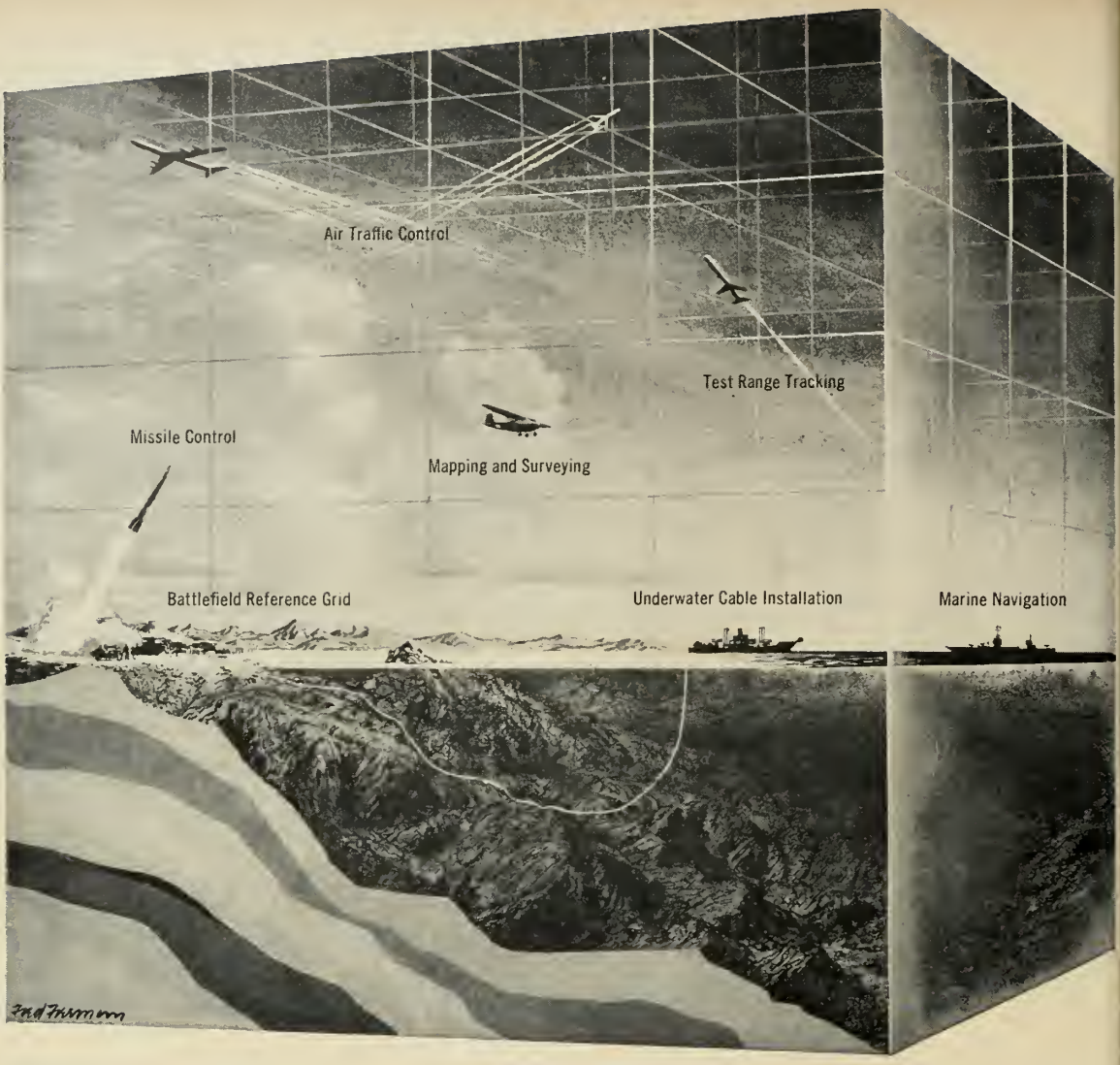


LORAN C: ACCURATE POSITION DATA IN EVERY DIMENSION

A new navigation system — Loran C by Sperry — now makes it possible to determine the position of aircraft and ships with far greater accuracy, and over a much greater range than ever before. Sperry is currently fulfilling test instrumentation and marine navigation contracts with the Services for this new system.

But a wide variety of tactical applications suggest themselves. For instance, Loran C can be applied to air-sea rescue, surveying, mapping, air traffic control, underwater cable laying and repair. It can provide position tracking for ships, aircraft, missiles, and satellites. It can be used to develop a battlefield reference grid to increase the effectiveness of field operations. And it can provide a highly precise time as well as position reference.

Developed by Sperry in cooperation with the Armed Forces, Loran C is a unique hyperbolic system which is not limited to line of sight. It extends the range of loran transmissions to 1500 miles and beyond . . . operates at ground level as well as at altitude. Compatible with the Loran A system, Sperry's Loran C is an advanced version of what has been called the most important radio navigation development of the postwar era. It is the most accurate long range area coverage system in operation.

SPERRY

AIR ARMAMENT DIVISION, *SPERRY GYROSCOPE COMPANY, DIVISION OF SPERRY RAND CORPORATION, GREAT NECK, NEW YORK*

Circle No. 4 on Subscriber Service card.

Shepherd Touching Off Interservice Row

ARPA's 'dark satellite' detection system still 'unassigned' although all three services have phases of the program

by Hal Gettings

Baa, baa, Shepherd, *have you any gold?*
Yes sir, yes sir, three bags full:
One for the Army; one for the Navy;
And one for the little ol' Air Force.

Project *Shepherd,* ARPA's "dark satellite" detection system, is apparently scheduled for a round or two of interservice rivalry. Already overdue for assignment to one of the military services, the program is still in the research and development stage—the assignment date remains somewhere in the future.

Familiarly known as "Insect" (INSSCC—Interim National Space Surveillance Control Center), the project's primary function is to develop a means to detect and track "dark," or passive, satellites passing over the U.S. These include known satellites whose transmitters no longer emit radio signals and unannounced "enemy" satellites which could be used for reconnaissance.

The system recently moved into the limelight when the Department of Defense announced the detection and tracking of an "unknown" satellite on Feb. 10. INSSCC successfully tracked the satellite and computed orbit parameters and life expectancy.

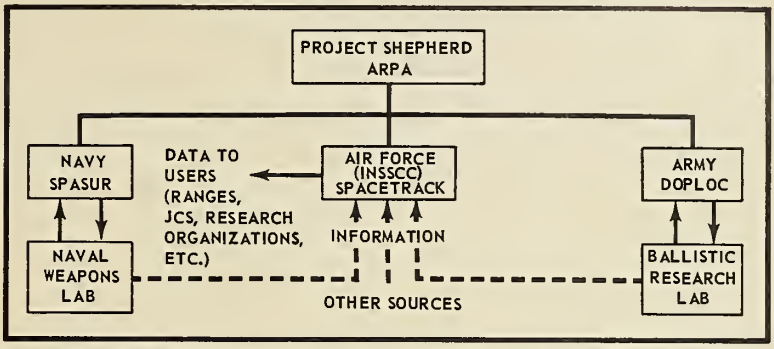
• **Three services involved**—All three services are presently involved in Project *Shepherd.* Navy has two east-west detection complexes (see map) and an R&D computation center at Dahlgren Naval Weapons Lab.

Army, with its "Doploc" fence—an alternate receiver system—fills in the center of the transcontinental system.

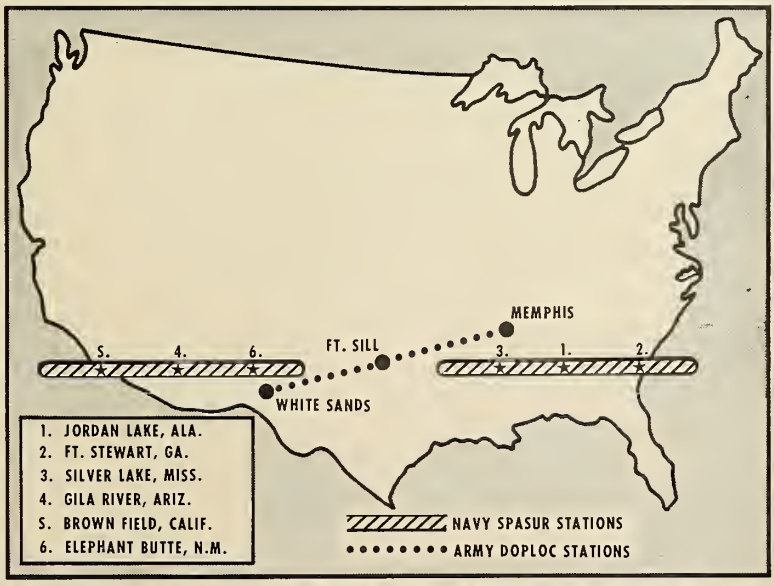
Air Force's Air Research and Development Command has set up a computation control center at its Cambridge Research Center which will gather data from the detectors and issue periodic bulletins on all existing satellite orbits. This facility, part of the Spacetrack program, is considered to be in development but is already operational to some extent.

Beyond this point, however, there seems to be considerable confusion as to exactly how the system will operate once it's past the interim stage. Army, apparently, may be pretty well out of the picture—its Doploc reportedly hasn't worked too well. Its portion of the fence is presently operating on a reduced schedule. This leaves Navy and Air Force as major contenders for system management.

Aeronutronic Division of Ford Motor Co. has just been awarded an ARDC contract as systems contractor



INTERIM SURVEILLANCE system involves all three services, with ARPA furnishing money and management supervision. Final system will logically be under one service with AF Spacetrack computation center handling all detection data and issuing periodic reports.



U.S. east-west fence is composed of two Navy SPASUR installations and one Army Doploc complex.

to study operations of the INSSCC to produce a system design plan for future expansion of the facility. Operational analysis studies on the space surveillance system will include communications, data handling, computation, prediction and observation net control. Eastman Kodak, Page Communications, Dunlap and Associates, and Raytheon are associate contractors.

Funding through Fiscal '60 totals approximately $31.5 million. This year's budget allotted $6 million to Spacetrack and $5.57 million to the Army and Navy combined—which may or may not be indicative of wind direction.

• **So far, so good**—Indications are that ARPA is pleased with the system to date. Developed and built on a crash basis, INSSCC was authorized in June, 1958, and completed in less than a year.

The Navy fence—developed from the *Vanguard* Minitrack—has worked well and results obtained from the interim equipment indicate that an adequate detection and prediction system is quite feasible.

Present performance characteristics are classified. Effective detection ranges are not known, but it is certain that satellites can be put into high enough orbits to escape detection by present equipment. Roy Johnson, former director of ARPA, recently stated that the system would operate out to 1000 miles.

Although evaluation time requirements have not been released, reduction and computational time is probably in the neighborhood of 24 hours. This would apply to both computer facilities since neither has automatic conversion and processing equipment.

• **Improvements needed**—Several things would have to be done to make the system fully operational and adequate to detecting and evaluating possible future satellites. Present operation is limited to space vehicles whose orbits cross the fence (32° North latitude). Satellites crossing the U.S. below this latitude would be undetected. A proposed spur would give wider coverage and faster orbit determination.

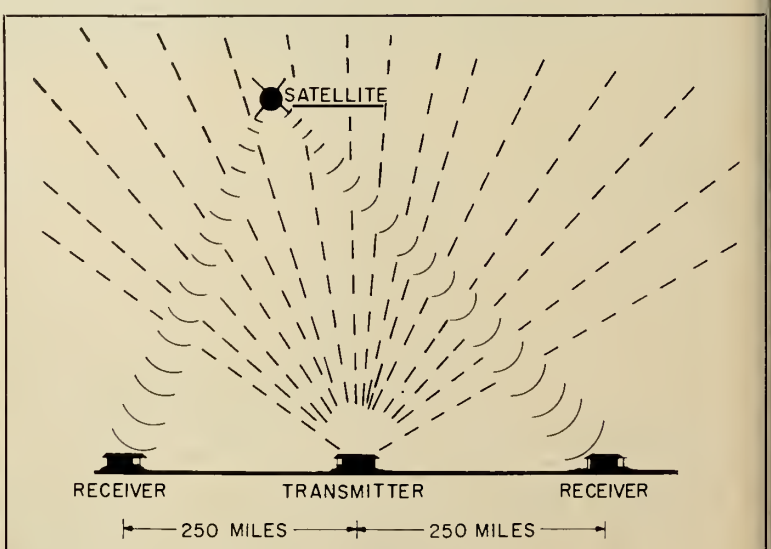
Ranges would be extended by upping the power of the radio transmitters and, possibly, by more sensitive receivers and higher-gain antennas.

Automatic data processing equipment is necessary to cut evaluation time. At present, detection information fed to the filter center must be manually reduced and converted to digital data to enter the NORC and IBM 709 computers. Automatic equipment also would upgrade the quality of input data to provide more precise orbit determination.

Plans for these extensions are extremely hazy at present, however, and neither ARPA nor the military agencies concerned appears willing to make any predictions as to the future of the program.

All involved agree that a satellite detection system such as this is needed. Those concerned with the problem feel that national security demands that we know the precise location at all times of any satellite orbiting around the earth.

• **Friend or foe?**—Detection is, however, only part of the problem. We

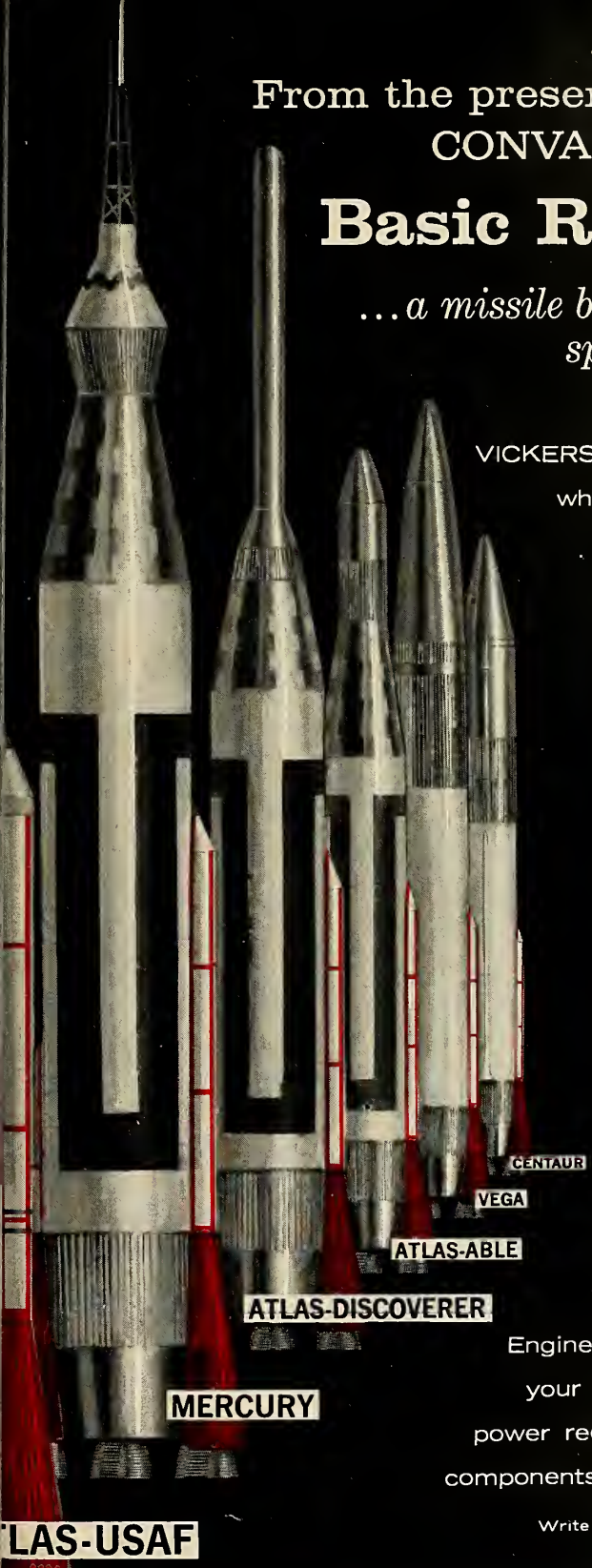


TRANSMITTED ENERGY is reflected from satellite to ground receiving stations. Radio interferometer techniques are used to precisely measure direction of received signals.

From the present USAF production ATLAS CONVAIR has developed a

Basic Research Vehicle

...a missile booster for peaceful scientific space exploration



VICKERS INCORPORATED supplies hydraulic pumps which provide reliable power for the vital job of gimballing all engines on the mighty Atlas. These pumps are part of a complete line of fluid power equipment with an industry-wide reputation for thorough engineering and precision manufacturing.

VICKERS, as a result of its participation in missile and spacecraft programs, has developed cryogenic, hot gas and other types of auxiliary power systems. Also available: electrical generating systems, actuator systems, and miniaturized power packages with integral controls.

Call in your Vickers Application Engineer to discuss your airborne fluid power requirements... components or systems.

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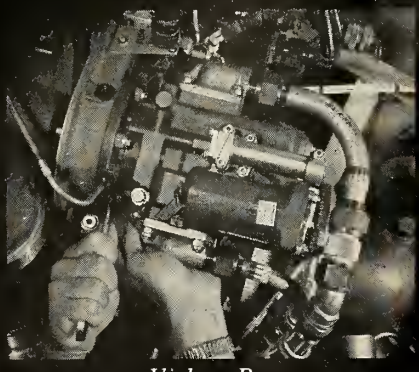


Vickers Pump Being Installed on Atlas

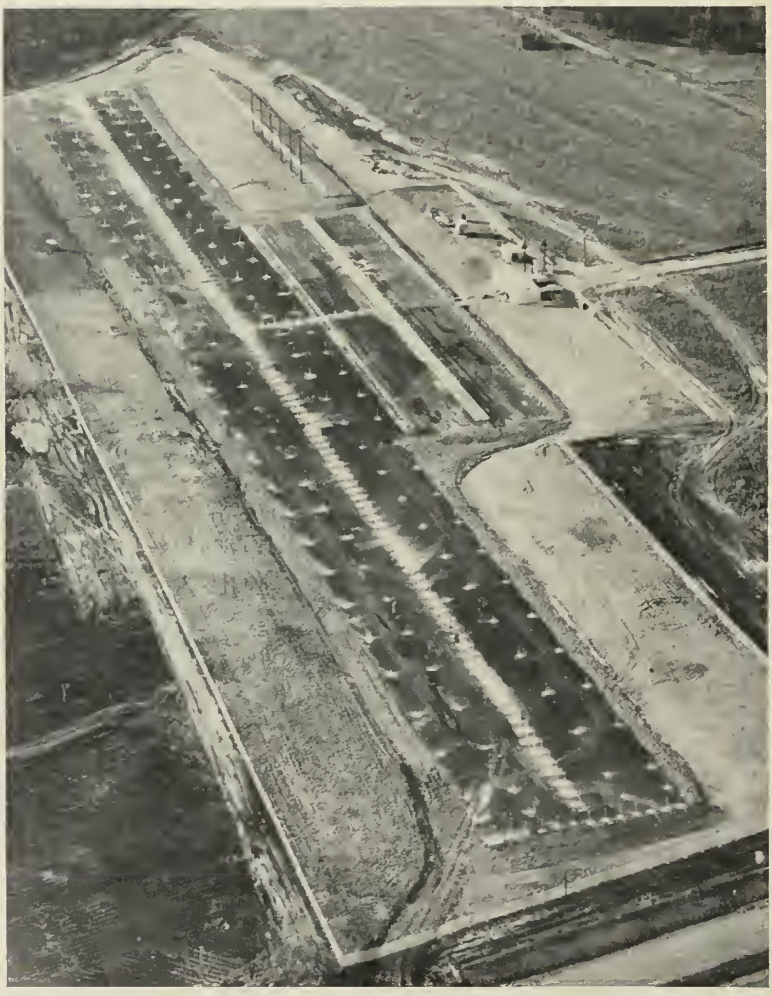
AERO HYDRAULICS DIVISION
VICKERS INCORPORATED
DETROIT 32, MICHIGAN

division of
SPERRY RAND CORPORATION

also need to be able to determine the function and operation of a suspected "unfriendly" satellite. And—once its "unfriendliness" is confirmed—what can be done about it.

It is logical to assume that such a vehicle would be disguised as a "peaceful scientific" type, and this compounds the problem. Even if we had the capability, shooting it down would make the U.S. subject to a barrage of unfavorable propaganda. One tongue-in-cheek suggestion to combat such a possibility is to arrange for the unfriendly "scientific" satellite to accidentally collide with another "scientific" satellite. Precisely maneuverable satellites are still somewhere in the future, however; this solution must await considerable refinement in the state of the art.

RECEIVING STATION antenna array is over a quarter-mile long and 300 feet wide.



NAVY USES modified Minitrack transmitting and receiving equipment. Transmitting stations, such as this installation at Jordan Lake, Ala., use 50 kw transmitters on a frequency of 108 mc.

Capt. Winfred Berg, director of the Naval Research Laboratory Space Surveillance program, has stated that the only solution lies in "hiding" from observation by a reconnaissance satellite. Knowing the precise location of the vehicle at all times would allow activities in areas under observation to be disguised, stopped, or changed to reflect a false picture to the observer. In addition, countermeasures might be used to fool the enemy or jam his reception.

• **Operates like radar**—Operation of the detection system is similar to that of radar. A transmitter is located at the center of each portion of the fence—Jordan Lake, Fort Sill, and Gila River. Stations on each side of the transmitter contain the antennas and receivers. The transmitters emit a continuous fan-shaped "curtain" of r-f energy into the sky along the line of receiving stations. The pattern is very narrow in the north-south direction and broad in the east-west. The receivers have similar antenna patterns and all are co-planar with the transmitter pattern so that a satellite entering the transmitter antenna beam also enters the receiver antenna patterns. The two receivers then receive the reflected energy from the satellite as it crosses through their patterns.

The receiving stations have the equipment necessary to measure very precisely the direction from which the satellite reflections arrive at each station. This measurement is accomplished through the use of radio interferometer techniques (Navy Minitrack stations) and doppler effects (Army Doploc stations).

The receiver information is then transmitted to the computation centers for orbital determination. Data from the Navy fence is sent to the Dahlgren facility, to Naval Research Lab, and a portion to the Air Force Spacetrack filter center at Cambridge. Doploc data is transmitted to the Army's Ballistic Research Labs at Aberdeen, Md. Present plans call for the Spacetrack facility to eventually serve as the computation center for all data.

• **Decision called for**—The big question—now that feasibility has been proved and agreement reached as to the necessity for space surveillance—is why nothing further is being done. The present interim system, although working, is certainly not adequate—as proved by its first announced detection of an unknown satellite. Data had been received for a considerable period—possibly several weeks—before the

Orbital Elements of Known Satellites in Orbit as of February 1, 1960

Satellite	Popular Name	Nodal Period (Min)	Inclination (Degrees)	Perigee Height (Statute Miles)	Apogee Height (Statute Miles)	Launch Date
1958 Alpha	Explorer I	108.9	33.2	218	1250	1-31-58
1958 Beta 1	Third Stage Vanguard I	138.2	34.3	402	2680	3-17-58
1958 Beta 2	Vanguard I	133.9	34.3	407	2450	3-17-58
1958 Delta 2	Sputnik III	93.0	65.1	116	410	5-15-58
1959 Alpha 1	Vanguard II	125.5	32.9	346	2050	2-17-59
1959 Alpha 2	Third Stage Vanguard II	129.7	32.9	345	2280	2-17-59
1959 Delta 1	Explorer VI	756.4	47.0	155	26,000	8- 7-59
1959 Delta 2	Final Stage Explorer VI		(Similar to 1959 Delta 1)			8- 7-59
1959 Eta	Vanguard III	130.0	33.4	316	2330	9-18-59
1959 Theta 1	Lunik III	22,700.0	80.5	25,100	297,000	10- 4-59
1959 Theta 2	Final Stage Lunik III		(Similar to 1959 Theta 1)			10- 4-59
1959 Iota 1	Explorer VII	101.2	50.3	346	670	10-13-59
1959 Iota 2	Final Stage Explorer VII	101.2	50.3	343	670	10-13-59
1959 Lambda	Discoverer VIII	96.0	80.7	116	600	11-20-59
Unknown 1-60	Discoverer V	104.5	79.0	134	1074	8-13-59

Navy recognized that a detection had been made. No red lights flashed and no automatic readouts started printing orbit calculations. In other words, the present R&D system requires a high order of skilled human vigilance and interpretation—or "eyeball" technique —to make it work.

The technical problems can be solved. A high-level decision is now in order—to assign the system to one responsible agency, lay out the operational procedures, decide what the final system will be, and appropriate the money to get the job done.

'Phothermionic' Image Converter Developed

A "phothermionic" image converter, an all-electronic device that changes received infrared radiation into a visible picture on a television screen, has been developed for the far-IR spectrum.

Disclosure of the infrared imaging device was made at the winter meeting of the American Institute of Electrical Engineers, by Dr. Max Garbuny, head of the team of Westinghouse research scientists that developed the system. The development was sponsored largely by Wright Air Development Center, U.S. Air Force.

Such radiation (long wavelengths) is emitted by comparatively cool objects such as the human body. Hotter objects, for example those that actually glow red hot, emit more energetic radiations of shorter wavelength in the "near" infrared, and are easier to detect.

The new device is sensitive enough to detect a moving object near room temperature when it exhibits temperature differences of approximately 20°F. This is just about the spread between the temperature of the human body and average room temperature. In addition, the system is fast enough to follow the movement of such objects with the same speed as a normally visible object is followed by the unaided human eye, said Westinghouse.

Key component in the system is a unique infrared-sensitive detector. It is a three-layer sandwich only a few millionths of an inch thick. The center layer of the sandwich is an ultrathin support film of aluminum oxide about one millionth of an inch thick. The film is made by chemically dissolving away all of the aluminum metal in a piece of suitably treated aluminum foil, leaving only the thin layer of aluminum oxide coating the surface of the foil.

The front surface of the oxide support film is coated with an even thinner layer of nickel, deposited in such thickness that it strongly absorbs TR radiation. The back surface of the film is coated with a thin layer of photoemitting material, cesium bismuth.

Of key importance is the fact that the photoemitter's ability to release electrons under the stimulus of light varies with its temperature, changing 2 or 3% for every degree its temperature changes.

To increase the overall sensitivity and performance of the detector, it is cooled to a temperature of about —180°F.

In use, the IR radiation from an object is focused on the heat-absorbing layer of the detector forming a temperature pattern of the image. The temperature pattern is transferred through the thin support layer to the photoemitting surface, where it can be perceived simply by scanning a spot of light across the surface. As the light spot scans the photoemitting surface, many or few electrons flow from the surface in exact conformity to the heat pattern on it. Electrical signals are then amplified and fed to a standard television picture tube.

50-Million-Hour Life Test Program Under Way

Military diodes and transistor life tests are now being performed by Clevite Transistor Products in an attempt to prove parts will function for up to 50 million hours under severe environmental conditions.

The company said tests are under way in its newly equipped reliability lab in Waltham, Mass.

Components are being subjected to

Marquardt ADVANCED PRODUCTION CAPABILITY for air and space

MARQUARDT/OGDEN RAMJETS FOR USAF-BOMARC PROVE 100% RELIABLE

Marquardt/Ogden delivered its first production engine to the Air Force in June 1957, one month ahead of schedule. This was achieved despite the problems of creating, building and implementing a modern production facility and staffing it with qualified engineers and technical personnel. In the more than two years since, each and every delivery has been as-per-contract-schedule, while Ogden ramjets have proved 100% reliable in all test flights of Bomarc IM-99A.

By strict adherence to a realistic learning curve, Ogden Division currently delivers its supersonic ramjets at far less than their mid-1957 delivered cost—this despite the ramjet engine system's relatively early stage of maturity.

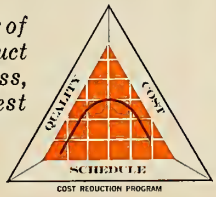
Recent expansion and additions further enhance Marquardt/Ogden's capability. In 1958 the plant doubled floor space to almost ¼ million square feet, with numbers of employees increasing 93%. 1959 marked Ogden Division's addition of a first-of-its-kind Spin Forge and completion of a new facility for explosive metal forming. Ogden's USAF-Marquardt acceptance test facility at Little Mountain gives the Division full-plant capability.

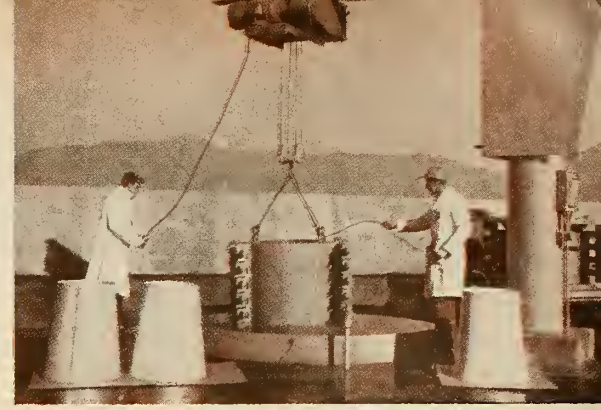
Marquardt/Ogden is now capable of producing space-age hardware in all of its basic configurations—cones, cylinders, rings, parabolic shapes—using the most sophisticated of space-age metals.

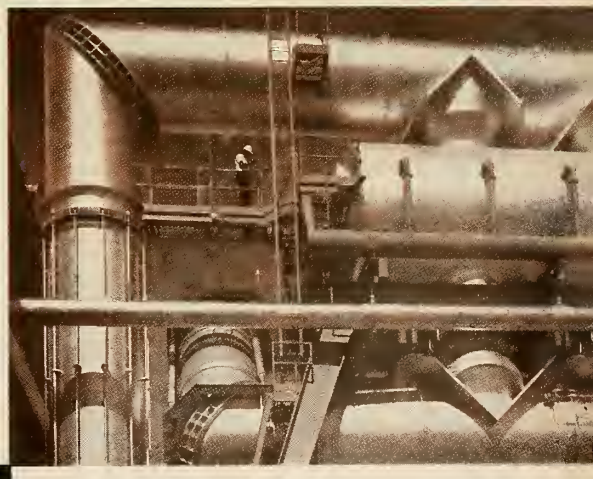
Responsible for Marquardt/Ogden's record are: a creatively cost-conscious management team headed by Mr. D. K. Tasker (pictured left); early application of industry's newest and most advanced production and metal working techniques; a facility cited by *Factory Magazine* as one of America's top ten; and the efforts of the Division's nearly 2,000 men and women workers. All combine to provide Department of Defense and Weapon Systems Managers with a unique capability for the on-time delivery of reliable space-age hardware at minimum cost.

For additional production capability specifics, you are invited to contact: Manager, Customer Relations Department, Ogden Division, The Marquardt Corporation, 1000 West 33rd Street, Ogden, Utah.

Current expansion creates a number of outstanding opportunities for: Product Development, Materials and Process, Manufacturing and Production Test Engineers; and skilled machinists.







OGDEN DIVISION

THE Marquardt CORPORATION

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POWER SYSTEMS GROUP

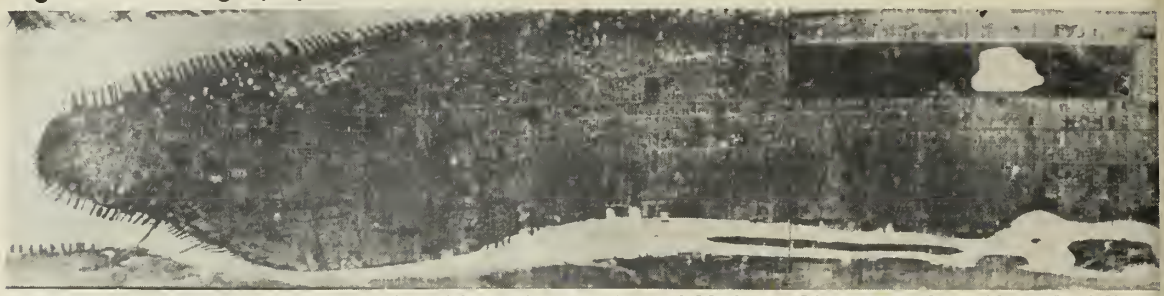
CORPORATE OFFICES: VAN NUYS, CALIF.

TOP. High energy (explosive) forming produces heretofore "impossible to form" shapes—typifies Marquardt/Ogden's continuing quest for optimum materials and processes which advance the art of metal fabrication.

CENTER. Marquardt/Ogden's massive Spin Forge is the most powerful of its type for cold-flow forming of space-age metals. It compliments the Division's new explosive metal forming facility and other specialized equipment.

BOTTOM. USAF-Marquardt Jet Laboratory-Ogden at Little Mountain, some 15 miles West of Ogden, acceptance-tests every production engine system produced by the Division; is capable of simulating flight at speeds in excess of Mach 3, altitudes above 100,000 feet.

Nighttime Photography with Infrared



JUST DECLASSIFIED BY DOD, this detailed nighttime infrared photo of Manhattan Island, was taken with an HRB-Singer, Inc. Reconofax from 4000 ft. Reconofax makes use of a scanning camera with an improved detector. Note clear definition of roads and paths in Central Park and detection of ships in the Hudson and East Rivers.

shock, vibration and stresses by equipment calculated to guarantee a more rugged treatment than would be experienced in missile blast-off or re-entry.

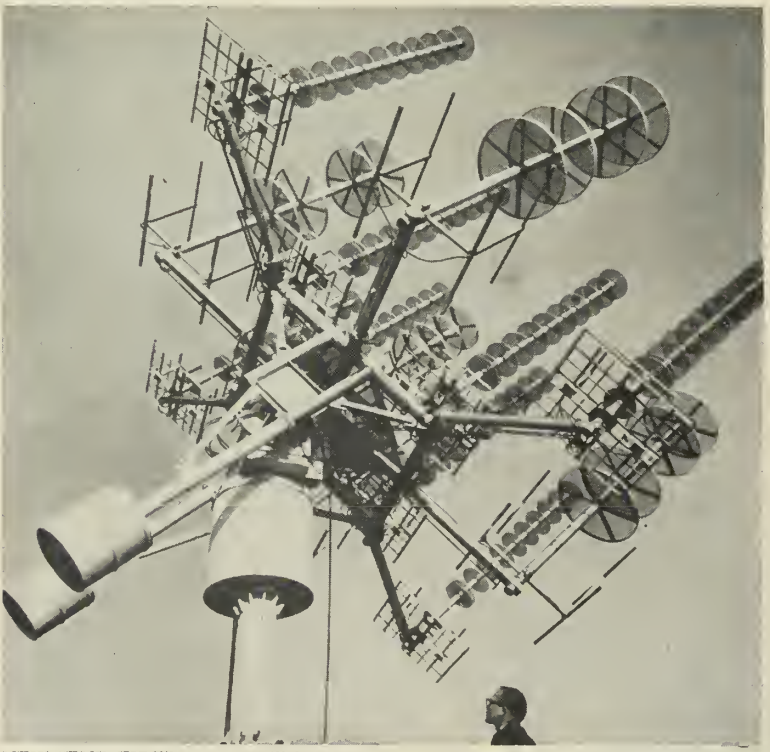
They also are baked, frozen, soaked and exposed to corrosive chemicals to test resistance to climate extremes.

Before this exposure, components are tested to meet rigid performance specifications. If they perform to the same specifications at the final check-out, they are approved as being of highest reliability. Final check-out includes visual examination under 30-power optical magnification.

In three programs now under way, diodes are tested from two weeks to a month and a complete history is recorded. Ultimately, data processing equipment will be used to analyze millions of individual histories to predict life potentials under various usages.

It is hoped that knowledge gained through reliability tests will make it possible to improve numerous electronics systems, particularly for future space stations, global communications and missile systems.

Antenna for Tiros



NEW "END-FIRE" antenna will be used to receive signals from NASA's Project *Tiros* meteorological satellite. Unique antenna, designed and developed by General Bronze Electronics, will be delivered to RCA-Princeton, one of the prime contractors in the satellite program.

Navy Tests Full-Scale *Polaris* Guidance System

The first full-scale test of a complete inertial guidance system for the *Polaris* missile was made Jan. 7 from Cape Canaveral, the Navy has announced. Three succeeding shots also have been successful, covering a distance of 900 miles. The last of these flights, on Feb. 10, brought into further prominence the role of the Massachusetts Institute of Technology's Instrumentation Laboratory in the development of the system.

The guidance, believed to be the most advanced system used by any U.S. ballistic missile, was designed, developed and assembled at the Instrumentation Laboratory in Cambridge, Mass. The lab, one of four major contractors for the Navy's Bureau of Weapons Fleet Ballistic Missile (FBM) program, is responsible for guidance system development.

Called "the most complex weapon system ever devised," one of the most difficult tasks, said an MIT spokesman, has been that of providing an inertial guidance system having guaranteed accuracy for the missiles if they are ever launched at sea against enemy targets.

Work on the application of inertial guidance began at MIT even before World War II. (First practical demonstration of the system was made in 1953 when Dr. Charles S. Draper, lab director, made a secret flight from Bedford, Mass., to Los Angeles in an aircraft navigated by the SPIRE inertial guidance system. Dr. Draper announced his accomplishment on arrival at a classified meeting on inertial guidance. This ancestor of today's light weight and compact system weighed 2800 lbs.

Similar to other systems designed at MIT for the Air Force *Titan* ICBM and *Thor* IRBM, the inertial package furnishes not only accurate but nonjammable guidance.

The General Electric plant in Pittsfield produces the inertial guidance systems in accordance with design specifications furnished by MIT.

F-1 Engine Design Goals Being Met

First year of work sees basic problems of engine design and fabrication solved as Rocketdyne completes full-scale mockup

Design goals have been met in all areas in the first year of work on the 1½-megapound-thrust F-1 engine, Rocketdyne Division of North American Aviation Inc. reports.

Tests and studies to date have confirmed solutions to the basic problems in engine design and fabrication and a full-scale mockup has been completed, Rocketdyne declared. (First photo of the mockup appeared in M/R Feb. 22, page 11).

Rocketdyne disclosed these other items of progress on the F-1 since it won the NASA development contract Dec. 17, 1958:

- Completely stable combustion has been achieved at more than 1,000,000 lbs. thrust, using a full-scale uncooled combustion chamber.
- The largest injector this side of the Iron Curtain has been tested successfully.
- Fuel and oxidizer model pump tests have verified design points chosen for the full-scale unit.
- Tests of model parts are successfully proving the design of a turbopump capable of moving fuel into the thrust chamber at a rate of three tons per second.
- Design of the gas generator has been completed.
- Construction of test facilities at Edwards AFB, Calif., is well under way after delays in certain areas caused by the steel strike.

The F-1 uses the conventional LOX-RP1 fuel combination to take full advantage of proven advanced concepts in high-thrust technology while providing maximum assurance that design goals and development schedules would be met on time, Rocketdyne said.

- **High hopes**—The F-1 is expected to be developed in about four years. NASA plans to use it in a cluster of four or six engines, providing from six to nine megapounds of thrust for a booster designed to lift very heavy payloads into space. NASA scientists envision a multistage *Nova* rocket that might tower as high as a 20-story building. The 10-year NASA space program calls for the first *Nova* flight in Fiscal 1968 and two more in 1969. The *Nova* will make it possible to put into orbit a 150,000-lb. space laboratory.

Tests to date have been conducted at Rocketdyne's Propulsion Field Laboratory in the Santa Susana Mountains near Los Angeles. Full-scale testing will be held at Edwards when facilities are complete.

The largest of three stands in the Edwards complex, designated Test Stand 1B, will rise 230 ft. over the Mojave Desert, at a cost of $12 million. The Del E. Webb Construction Co. is pouring 12,000 yards of concrete for footings, enough to pave a mile of eight-lane freeway, under the supervision of the Army Corps of Engineers. Aetron Division of Aerojet-General Corp. designed the foundation structure.

Exhaust flames from the giant engine will be directed downward and outward against a 260-ton steel deflector, protected against the heat by water flowing at 60,000 gallons a minute.

Since water is scarce in that part of the country, the water will be conducted to a small lake and conserved for future tests.

Another stand, Test Stand 2A, is almost complete on the opposite side of Luehman Ridge. Here, the F-1 thrust chambers, less their pumping mechanisms, will be fired at a 30° angle off the ridge. First testing at Edwards will take place at 2A.

Test Stand 1A, the third location, is being restructured from a stand formerly used in testing the now-operational *Atlas*. The engine will be fired 130 ft. straight downward from Stand 1A before exhaust flames reach a water-cooled deflector cradled in a rock gully.

The major contractors on Stand 2A are R. M. Parsons Co., Mid Valley Utility Constructors, Alex Robertson, Southwest Welding and Manufacturing Co. and Chicago Bridge and Iron. On Stand 1A, the main contractors are Kaiser Steel, Southwest Welding and John A. Minasian.

Fueling Satellite Proposed

PHILADELPHIA—A space "filling station" that could increase the range or payload of space missions by a factor of 10 is proposed by a Norair research scientist.

The fueling satellite—called PROFAC (Propulsive Fluid Accumulator)—was described at the AIEE Magnetohydrodynamic Symposium by Dr. Sterge T. Demetriades. Use of such a technique would cut the ratio of booster rocket weight to payload from 300:1 down to 30:1, he said.

PROFAC would be a manned air-gulping powered satellite in a 60-70 mile orbit around the earth. It would accumulate air, liquefy it and store it. Part of this air would be used to power the satellite and the remainder used to fuel outbound space vehicles.

The satellite power would be provided by a ramjet using magnetogasdynamics principles. A small part of the collected air would be used to form a jet of highly accelerated ions. The ion stream would be further accelerated and mixed with a stream of air molecules. The ions would force the air molecules out of the ramjet's exhaust nozzle at 50,000 fps, or higher, to produce thrust.

According to Dr. Demetriades, the principal problem is in the magnetogasdynamic or electrical acceleration of the air for propulsion. Technical knowledge and hardware for liquefying the air are already available, he said. The air would be accelerated by

electric or magnetic fields generated with the use of a nuclear reactor and electrical power-generating equipment.

The booster necessary to put the PROFAC satelloid into orbit would be on the order of the six-megapound *Nova*, he said. NASA has programmed the first *Nova* launching for 1967-68. The PROFAC would weigh between 76,500 and 125,000 lbs. without the liquid air.

It could collect, liquefy and store up to 500,000 lbs. of air a day from the tenuous atmosphere at that altitude, he said. Part of the air collected would serve as propellant to overcome the small drag at that altitude.

The Demetriades proposal is somewhat of an elaboration on the Project *Pluto* nuclear ramjet. In *Pluto*, air passing through the center of a nuclear reactor will provide propulsion for an aircraft. However, a *Pluto*-powered vehicle would operate at much lower altitude.

Pluto is jointly sponsored by the Air Force and the Atomic Energy Commission. Lawrence Radiation Laboratory of the University of California is working on the reactor system for the AEC. The Marquardt Corp. is doing engine design and development with Air Force funds. Atomics International, a Division of North American Aviation is studying reactor materials.

Two other companies have completed studies for the Air Force of a missile powered by a *Pluto* ramjet under Project *SLAM* (Supersonic Low Altitude Missile). They are Chance-Vought and Convair Division of General Dynamics Corp.

GE's X405H Completes Pre-Flight Rating Test

General Electric's X405H engine, which was to be the upper stage of *Vega*, has completed its pre-flight rating test.

The X405H, an advanced version of the X405 first-stage *Vanguard* engine, has been under development since last March. The *Vega* program was cancelled in December. However, since the X405H was so close to PFRT, NASA decided to complete it and have one more fully qualified engine in its inventory.

M. E. Disney of Los Angeles, West Coast flight propulsion specialist for GE's Rocket Engine Section, said the engine was operated for more than 2000 seconds in 12 consecutive static firings without component change or repair. The tests included shutdown, simulated coast periods and restarts.

The X405H, like its predecessor, uses LOX-JP propellants. Thrust was scaled from 27,850 to 35,000 lbs. Ignition was changed from single at sea level to multiple at altitude.

Vega was to have used the X405H atop an *Atlas*. The program was cancelled in favor of *Thor-Agena*, which already had developed high reliability, in view of the rapid progress of Pratt & Whitney's liquid hydrogen-LOX *Centaur* engine. The high-performance *Centaur*, also to be used atop an *Atlas*, is expected to be available within less than a year after the *Vega* would have been ready. NASA has scheduled the first *Centaur* shot for the spring of 1961.

Grand Central's *Saber* Is Better, Cheaper *Viper*

The *Saber*, a new solid-propelled rocket designed for sounding, drone boost and sled propulsion, has been introduced by the Grand Central Rocket Co.

Saber is a modernization of the GCR *Viper*, with a slightly greater performance, although the cost will be lower. *Saber* provides a total impulse of 33,000 lb.-seconds, at an average thrust level of 11,000 lbs. This compares with *Viper* impulse of 28,350 lb.-seconds at average thrust of 8100 lbs.

GCR said the *Saber* will sell for about $1000 in production quantities. *Viper* cost has been about $1500.

Saber, about 6 in. in diameter and 100 in. long, will weigh 210 lbs. It uses a nitrile propellant with some addition of aluminum, in a formulation that develops specific impulse of 230 sec. *Viper* uses polysulfide/ammonium perchlorate propellant and weighs 200 lbs.

Atlas Sustainer Reaches 481 Seconds

A 60,000-lb.-thrust *Atlas* sustainer engine was fired for 481 seconds in the Propulsion Laboratory of North American's Rocketdyne Division last month.

Rocketdyne said it was the longest firing duration ever made in the laboratory by a high-thrust rocket engine. In flight, the *Atlas* sustainer normally burns for a little over four minutes.

The sustainer is one of five engines that make up the *Atlas* powerplant, all of which are ignited at launch. The two booster engines, each with about 150,000 lbs. thrust, burn for about two minutes and then fall away. In addition to the sustainer, there are two vernier engines with 1000 lbs. thrust each.

After the sustainer burns out, the verniers supply thrust to provide fine attitude control and final thrust trim. In January, a vernier engine was burned in the laboratory for 1930 seconds.

THOR
MACE
TITAN
HAWK
ATLAS
SNARK
NIKE B
BOMARC
NIKE ZEUS
SPARROW I
SPARROW II
SPARROW III
NIKE HERCULES
SIDEWINDER
REGULUS II
VANGUARD
REDSTONE
JUPITER C
PERSHING
BULL PUP
MERCURY
POLARIS
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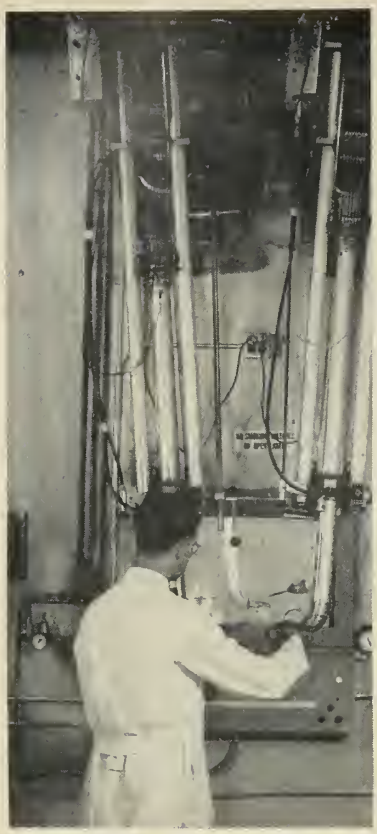
NEW DEPARTURE

MINIATURE & INSTRUMENT BALL BEARINGS

proved reliability you can build around

Atomic 'Slave' Used For Propellant Study



OPERATOR places dangerous chemical in beaker while standing outside chamber.

A master-slave manipulator, a device developed for handling highly radioactive materials, has been installed at a Thiokol Chemical Corp. laboratory for research in solid propellants.

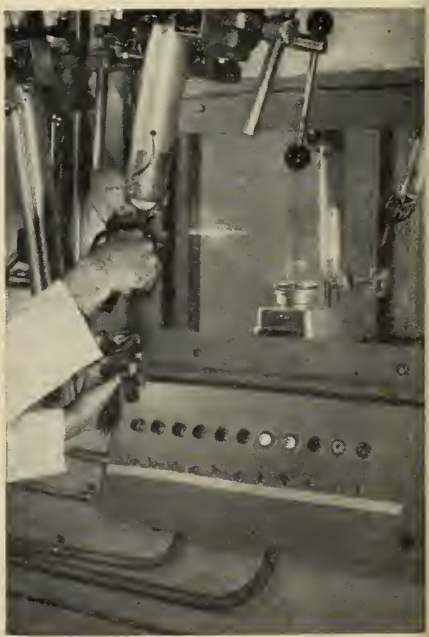
Thiokol said the manipulator, which will begin operations this month at its Elkton, Md., division, will be the first of its kind in the solid propellant industry. It serves two purposes: more rigid control of contamination of the experimental material, and safeguarding of personnel.

The "slave" duplicates all arm, wrist and pincer motions made by the operator grasping the master control outside the remotely controlled laboratory, which is protected by steel-reinforced walls 12 in. thick. A large window provides a clear view of most of the working area within the chamber. Pressure strength at the port is supplied by use of two transparent plastic sheets 1 in. thick, separated by an air gap 1 ft. wide.

The manipulators were funded by a $606,750 propellant research program granted to the Elkton Division recently by the Air Force. They were developed originally for the Argonne National Laboratory of tbe Atomic Energy Commission by AMF Atomics Division of American Machine and Foundry Co.

The Air Force contract calls for research aimed toward improved solid-propellant formulations for use in large rocket engines. The remotely controlled laboratory will enable an operator to remotely mix, cast, cure and radiographically test small ballistic test motors without having to expose himself or the propellant either during or between operations.

TECHNIQUE BORROWED from Atomic Energy Commission enables operator to stand safely behind transparent plastic ports.



MANIPULATOR DUPLICATES all arm, wrist and pincer motions made by remote operator.

Rover Can Be Accelerated If NASA Wants, AEC Says

Spokesmen for the Atomic Energy Commission declared last week they could develop the Project *Rover* nuclear rocket at a faster pace than demanded by requirements given the commission by the National Aeronautics and Space Administration.

The statement was made to the House Space Committee by Brig. Gen. Irving L. Branch, chief of AEC's Aircraft Reactors Branch, and his deputy, Col. Jack L. Armstrong.

Armstrong disclosed AEC plans for the firing of a *Rover* rocket 1000 miles into space by the mid-1960's. The vehicle would weigh 40,000 lbs., including a 1000-lb. payload, Armstrong said. He gave these other details:

Power would be provided by a reactor with 1000 megawatts thermal power, which would generate 52,000 lbs. thrust at liftoff and would continue in operation several minutes longer than a liquid-fueled chemical rocket.

• **Nuclear APU's**—Branch also told the committee that nuclear auxiliary power units are technically ready for use in satellites but are not being used because of fear of adverse international reaction.

Dr. Hugh Dryden, deputy NASA administrator, testified that NASA had written to the Budget Bureau supporting the AEC schedule for completion of ground testing. On the AEC proposal for firing a *Rover* rocket from the ground, Dryden said the experts in both AEC and NASA are in disagreement. He said some favored a start from orbit.

• **Off again—on again**—The Budget Bureau had stretched out the completion of the Project *Rover* ground test from 1963 to 1964. After an appeal by AEC Chairman John McCone, the commission was authorized to follow the original schedule but no additional funds were provided. The AEC was told it could shift funds to *Rover* by reprogramming.

Dryden told the committee NASA feels a sense of urgency about the nuclear rocket program. "We regret that metals and materials are so intractable," he said.

ARDC Punch Card File Will Keep Tabs on Research

Air Research & Development Command has begun the establishment of a punched-card file of all aerospace research in progress in this country, in and out of government.

The file is expected to become operational in about six months. ARDC now has such a file of all its own current technical efforts, set up for quick retrieval of information.

ARDC spokesmen said that, in addition to making it possible to keep better track of research in progress, the file is expected to pinpoint areas where more research emphasis is necessary.

Motors Checked by X-ray At Rocketdyne Facility

A 300,000-volt X-ray machine was put into operation last month at Rocketdyne's McGregor, Tex., plant to improve control over the quality of solid-propellant motors.

A 300 KV X-ray is capable of penetrating about 2 ft. of cured propellant or about 4 in. of steel. It will be used to examine propellants after they have been cast into a case and to check case weldings for internal imperfections.

Al-Mg Alloy Strength Is Boosted by Temper Process

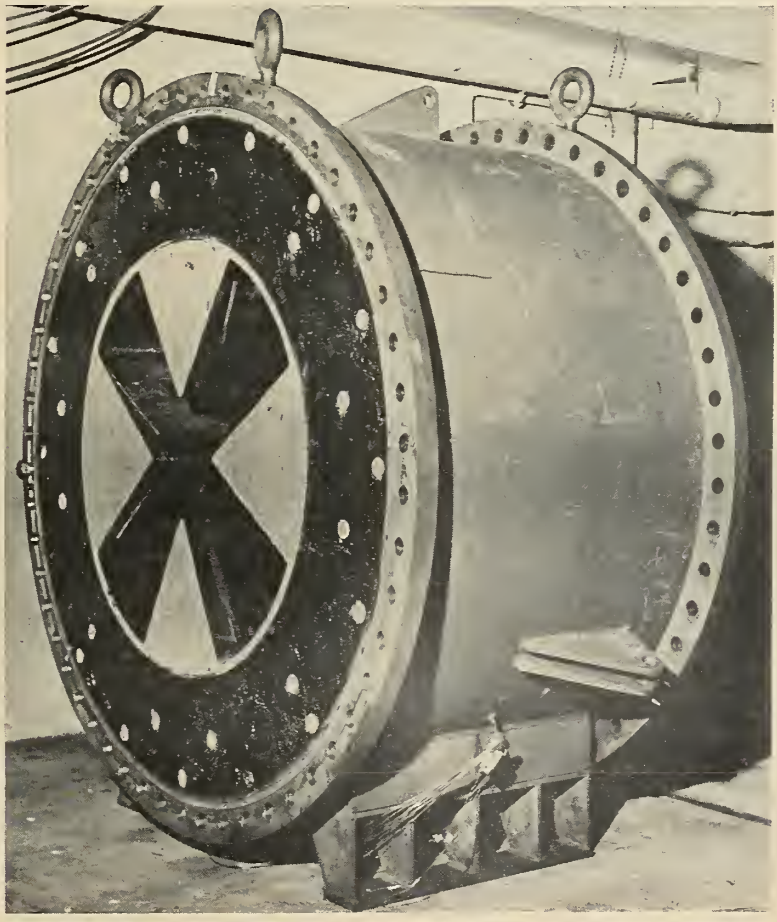
A new tempering process which increases the strength and reliability of the aluminum-magnesium alloys 5456 and 5083 has been announced by Aluminum Company of America.

The two new tempers, designated –H323 and –H343, assure a maximum resistance to stress corrosion in the sheet form. R. A. Sweet, Alcoa's sheet and plate sales manager, said that high properties were previously obtained by cold working. This increased the metal's susceptibility to stress corrosion.

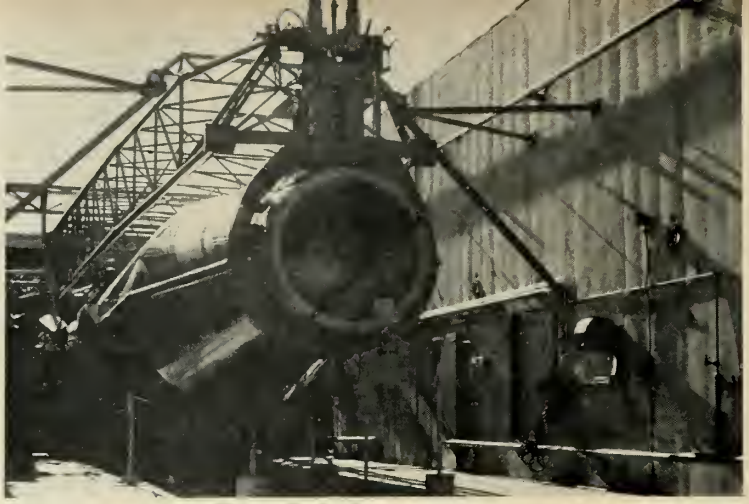
The new process gives the 5456 alloy a 4% increase in minimum tensile strength over previous methods. The sheet in these alloys has found wide use in highly stressed missile products since their introduction by

Company spokesmen did not disclose details of the tempering process.

Thiokol Casting



HUGE SLICE of solid-propellant motor, 70 in. in diameter, was cast at Redstone Division, Thiokol Chemical Corp., under study begun in 1952, proving feasibility of technique. However, Thiokol recommends on-site loading for multi-million-lb. thrust motors currently proposed.



ATLAS and erector system in "coffin" type, aboveground site. Roof is opened. Vandenberg has three such installations. The erector system is almost identical to standard Atlas transporter-erector. This and other illustrations are first photos, taken exclusively by M/R.

ground support equipment

Three More *Atlases* Near Combat Status

by Richard Van Osten

VANDENBERG AFB, CALIF.—Three more *Atlas* ICBM's—the first in truly combat launch pads—are about to join the nation's big missile strike force.

The three "coffin" type launchers now have missiles installed in their horizontal erectors and are fully instrumented. Although the Air Force has not officially designated them operational, it is believed these missiles could be pressed into service now if required. They are expected to be turned over to the Strategic Air Command in 30 to 60 days.

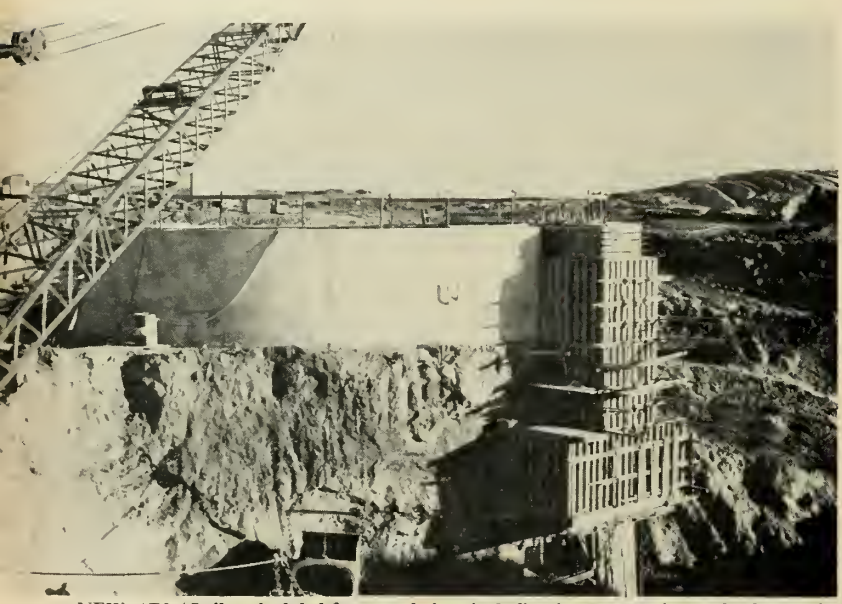
They bring to six the number of *Atlases* on launchers at this sprawling training and operational SAC base—the country's first. The other three *Atlases* are in R&D-type gantry pads nearby, overlooking the Pacific. They have been operational since September.

A closeup of launch facilities was given to the press for the first time recently by the 1st Missile Division. One *Atlas* was in a gantry, a second on the gantry pad, but not erected, and the third was indicated as being in full operational "hot" status. These pads are used for training as will be the second group of three above-ground "coffin" launchers.

It would appear that because of training requirements not all of the six missiles, which are capable of hurling hydrogen warheads at Russia, would be in a 15-minute alert status at the same time. At least one in each complex probably would require extra time to be fired.

Some details of how these missiles function on an operational basis were disclosed during the tour. Newsmen also were given a look at the silo-type "hard" launchers being constructed here for both *Titan* and *Atlas*—as well as other facilities being built under the base's $200-million construction program.

• **Secret pouch**—Each *Atlas* launch control officer while on duty wears slung around his neck a small, sealed pouch that looks not unlike an amulet to ward off evil spirits. The contents are a closely-guarded secret. But, rather than mandrake root and a dried newt's wing, the pouch is believed to hold a



NEW *ATLAS* silo scheduled for completion, including instrumentation and other equipment, by end of November. The silo is 174 ft. deep and 52 ft. in diameter. Launch Control Center (LCC) will be located 100 ft. from the silo and connected by tunnel. LCC is 40 ft. in diameter and 27 ft. high. Covered with six ft. of earth, LCC will have two floors suspended from the center post to minimize groundshock on sensitive equipment. The missile crib installation in the silo is octagonal, with wall thickness varying from six ft. at silo top to two ft. at the base.

frequently changed code which enables the launch officer to verify commands for an "in-anger" shot.

Such a command would be received from SAC headquarters in Omaha over one of the two red telephone "hot lines" in the launch control center. Once it was issued, the launch officer would open the pouch and be able to verify the correctness and authenticity of the order. The Air Force says that there is one more check of "fire" command information before the key is turned for launcher power "ON" and the countdown is started.

The procedure—all part of what the Air Force calls "positive control," which is the ICBM counterpart of "fail safe" for SAC bombers—calls for verification of the "fire" order by "another command post" on the base, presumably the base commander. If still in doubt, the launch control officer could pick up his second red telephone and call 15th AF Headquarters, March AFB, Riverside, Calif.

The officer who wears the pouch is required to carry a sidearm at all times. The pouch never leaves his possession until handed over to the officer who succeeds him on duty.

• **Shock-guarding** *Atlas*—The *Atlas* silo is due for completion—including instrumentation and elevator erection equipment—by the end of November. The silo is 174 ft. deep and 52 ft. id. The launch control center (LCC) is located 100 ft. from the silo by a connecting tunnel. Covered with six feet of earth, this domed 40-ft.-diameter by 27 ft.-high structure will have two floors. Both will be suspended from a center post to minimize ground shock to sensitive equipment in the event the base is hit by an enemy nuclear warhead.

The silo's wall thickness varies from 6ft. at the top to 2 ft. at the base. The bottom is 8-ft.-thick concrete. A flame deflector will be mounted on the elevator similar to the plan for "hard" *Titan* launchers. The design is simpler than *Titan's,* however, and the smaller service silos put in the first *Titan* complex here have been eliminated. To accommodate these integral facilities, the *Atlas* missile silo has been made deeper and wider.

Launches at the *Atlas* gantry and "coffin" type horizontal pads may be held at 2½ sec., if necessary. The roof of the "coffin" launcher moves lengthwise off the missile on railed supports in something under 20 secs. to permit the missile to be raised into firing position. Automatically actuated, threaded alignment pins hold the bird in a precise pad position until launch.

For static firings, or combat launches, cooling water is eliminated. Instead, the flame deflector has an eroding or ablating concrete surface which can take the intense heat.

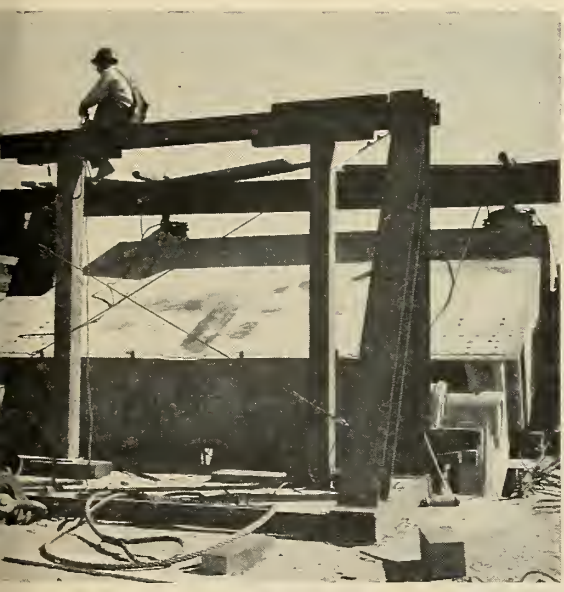
• **Four levels for** *Titan*—An extra level has been added to the *Titan* silo here for test and development operations instrumentation. Combat silos, such as those at Lowry AFB, Denver, will have four levels. The silo is about 165 ft. deep and 30 ft. id. and the launch control center is at the end of an 800-ft.-long tunnel.

Surface doors to the silo weigh about 280 tons each. Exact time for opening the huge doors and raising the missile to firing position is classified. But it is believed to be under 10 minutes.

In addition to the *Atlas* and *Titan* facilities already described, two more *Atlas* pads of the "Hollywood hard" configuration are under construction. These pads, requiring the missile to be raised from a horizontal position to fire, are being built into earthen revetments to make them better able to withstand a nuclear ground shock. At combat bases, they will be built flush with the ground.

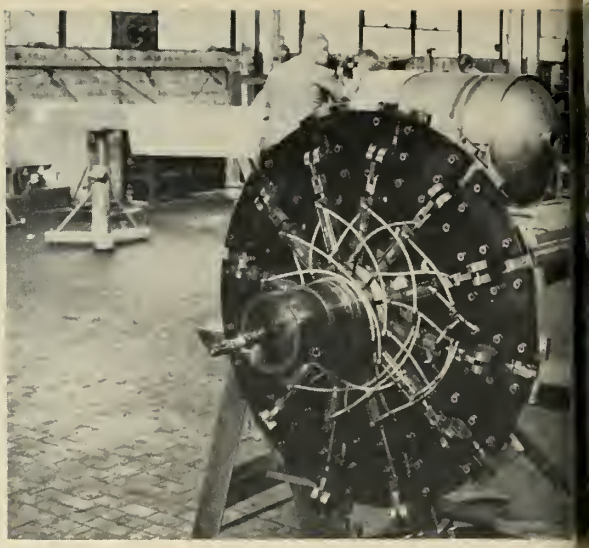
• **Gaining experience**—At the moment, construction of *Titan* and *Atlas* ICBM silos and their related facilities is being pushed at the most rapid pace possible. One reason is that final configuration of other silo-type installations will depend greatly upon Vandenberg's experience. Not all the engineering approaches have been worked out. Some "cut-and-try" approaches are still being considered, but solutions appear to be not far away.

Base officials estimate (probably conservatively) that major construction may continue for at least two more years.



DOORS OF *Titan* **silo weigh about 280 tons each. Engineers say that 3,000,000 pounds of concrete are used in the two doors. The exact time needed to open the doors, lift the missile and fire it is classified, but expert estimates are that it is considerably under 10 minutes. The somewhat portly workman gives an idea of the size of the doors.**

INTERIOR OF the 800-ft.-long access tunnel to *Titan* **silo. Entire tunnel is lined with bolted, riveted and welded circular steel rings to guard against ground shock. The trays at the left carry instrumentation and other electrical cables to the silo from the control center. There are sub-tunnels for routing utilities to the missile.**



THREADING operation being performed on a motor case. Note the sheer bulk of the machining tool necessary to insure that the threads have the required precision.

advanced materials

Buttress Threading Cuts Case Weight

This method shows promise of higher efficiency in tackling the problem of attaching aft closure heads

One of the biggest headaches in the fabrication of large solid-rocket motor cases is in the method of attaching the aft closure heads.

Buttress threading, the latest effort to cut the weight of these fittings while maintaining high efficiency, is being developed at Merz Engineering, Inc., Indianapolis, Ind.

This type of fitting is only one of several alternative methods of attachment, but it shows the most promise. Among the other methods are breach-lock, key-lock, bolting and standard threading.

A buttress thread is normally used for unidirectional power transmission. Such a thread usually has an included angle of 45° and one face is a right helicoil. There are slight variations, but the familiar forms appear in jack-screws and gun breech locks.

The peculiar nature of motor casings necessitated development of some specially designed tooling. The ultra-high precision involved made the task even more difficult. Merz designed and built a giant thread milling maching to do the job. The machine, which is featured on the cover of this issue, can handle large cases with accuracy and precision.

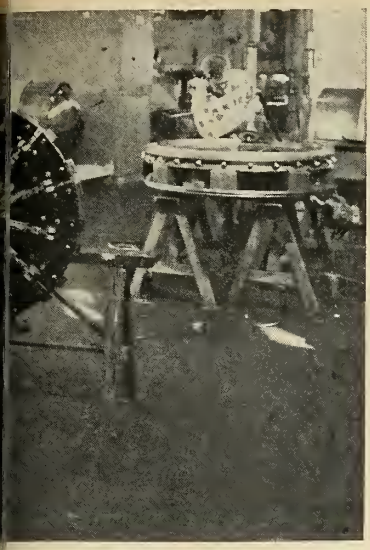
• **Keeping it round**—Preserving the perfect roundess of motor cases while machining them was another major problem faced by the firm. No matter how closely production is controlled, a large case whose aft closure is unattached will inevitably relax into an oval shape. To solve this, Merz engineers came up with an expandable mandrel which slides inside the case and supports it during the threading operation. This mandrel pushes the case into perfect round through the action of hydraulic pressure on pie-shaped sectors.

The case is first rounded up manually with an external band having 48 adjustable shoes. While this device is in place, the expandible mandrel is inserted and automatically adjusts the shape of the rounded case. Then the external band is removed.

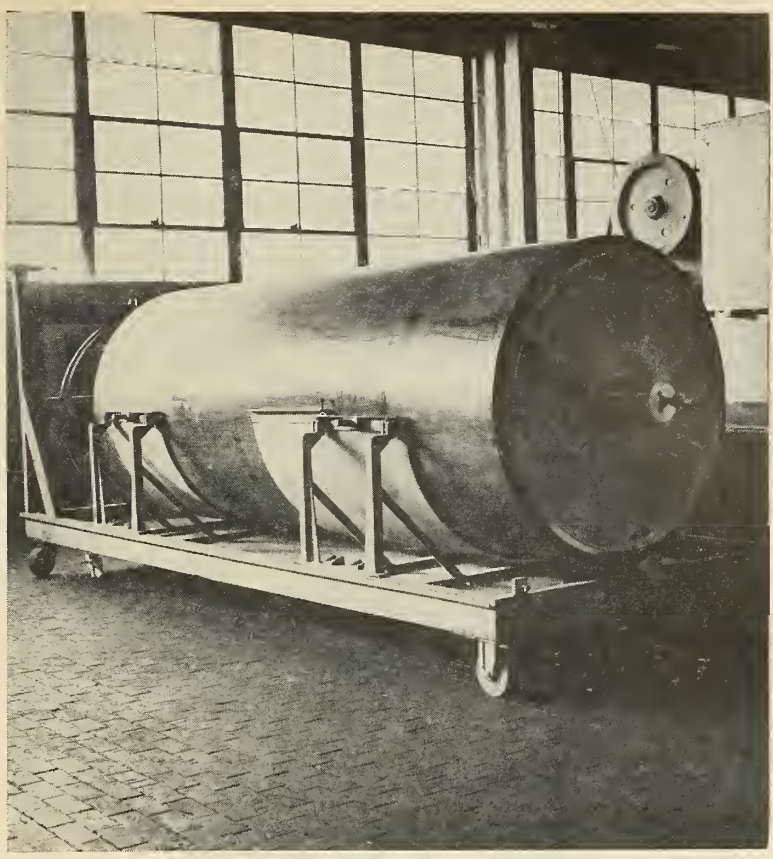
After insertion of the mandrel and before machining, a motor case is checked optically to insure the absence of ovality.

The motor cases illustrated are of 5% chrome hot-worked die steel. The aft closure being threaded on this week's cover was machined from a single piece of metal. The present cost of three-dimensional contour milling operation is about $5000 per head. Merz has designed a milling instrument which will reduce this cost by about a third, but this device is not yet in the hardware stage.

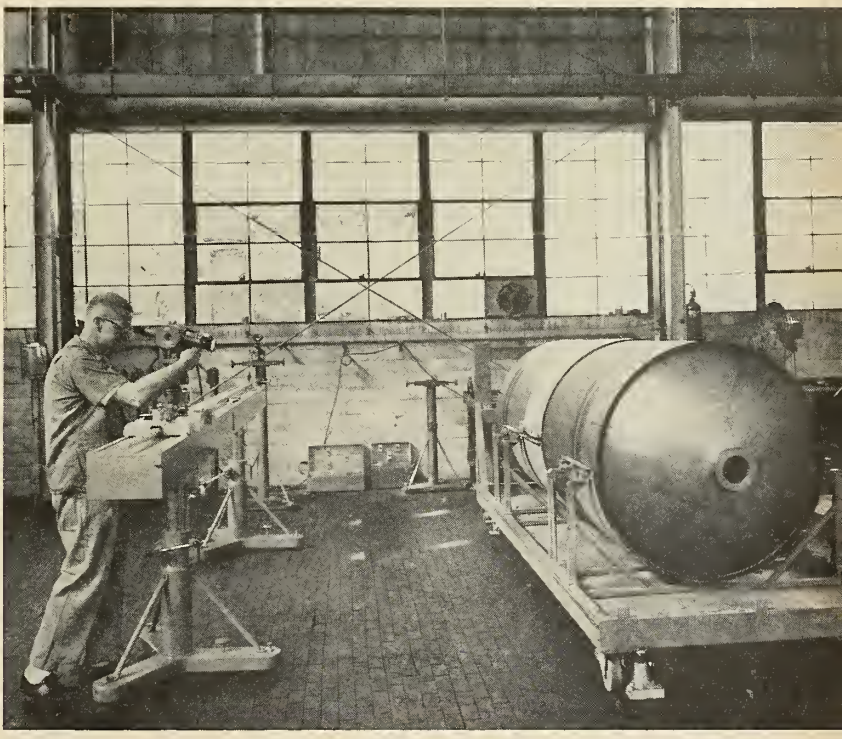
The thread milling machine is capable of handling cases up to 84 in. diameter without difficulty. The instrument may also be used to face and angle both the case and the closure head. Merz does not perform this oper-



EXPANDABLE mandrel for "rocket ounding" as it appears before being in- erted into a motor case. Twelve hydrau- ically operated sections push the case into perfect round.



MANDREL is visible in the open end of this case. The special handling dolly eliminates the possibility of scratches while the workpiece is being moved from tool to tool.



OPTICAL checks are taken before machining commences to assure that the configuration of the motor case is perfect.

ation with the milling machine but company spokesmen say it can be done with relative ease.

The thread milling machine is also used for milling skirts on the motor case and making the igniter tube boss on the aft end.

An improved unit has been supplied to the Allison Division of General Motors. This machine is capable of milling even larger cases.

The idea of buttress threads in aft closures was first conceived by GE's Rocket Engine Section.

The motor case machining developments were performed under a contract with General Electric's Rocket Engine Section, Cincinnati, Ohio. Merz provided the injection head for the *Vanguard's* first-stage motor and is doing metal work on the J-93, GE's nuclear aircraft engine.

Oxygen Source

Water Electrolysis May Give Air to Astronauts

Future astronauts may breathe oxygen generated through a process known for many years—the reduction of carbon dioxide with hydrogen and the recovery of oxygen by the electrolysis of water.

John R. Foster of Battelle Memorial Institute, Columbus, O., told the 42nd National Meeting of the American Institute of Chemical Engineers in Atlanta that the process appears to be substantially superior to other methods considered.

"The apparatus has potentially a low weight, great reliability, and good efficiency with low power and energy consumption," he said.

The well known reaction has been studied extensively as a part of the technology of gas manufacture, Foster said, but the published information is not generally applicable because of the difference in objectives. The gas industry uses the process to produce fuel gas while the Battelle study involved converting gaseous carbon dioxide into solid carbon and water.

Such an oxygen-producing plant is necessary to manned space flight because of the impossibility of carrying an adequate supply of oxygen. The study was part of a project sponsored by the Air Force's Air Research and Development Command.

High-Altitude Simulator Being Built for *Mercury*

The *Mercury* capsule and its occupant will be able to dive from 225,000 feet to sea level in six seconds —yet never leave the ground.

A huge high-altitude simulator being built by Tenney Engineering, Inc. at Cape Canaveral will provide an environment comparable to that 40 miles above the earth, with dive rates, to check the functioning of the capsule.

Robert H. Brown, vice president of Tenney, said that the six-second "descent" is an emergency factor. Normal diving will be controlled from zero to 50,000 feet per minute.

The chamber will be 12 feet in diameter and 15 feet high. The capsule will be admitted through the top. An adjoining anteroom will go up to 45,000 feet and will be used for observation and as a safety entrance.

The astronaut's only link with the outside will be through an unbilical cord which will contain the oxygen feed, intercom and various control and signal lines.

Sweden Seeks Three Rocket Types

ts industry is ready to begin project— ut government funds are limited

by an M/R Correspondent

STOCKHOLM—Project *Aurora* is the ame of a proposal for Swedish space esearch rockets submitted to the wedish Space Research Council by he Swedish Astronautic Association. he proposed program, based on an xisting Swedish rocket engine, would rovide three different rockets for vari- us altitudes.

The main elements in the *Aurora* ystem are one larger and one smaller low-burning rocket stage, and fast- urning solid-fuel rockets. By combin- ng these in various ways it is possible o build three rocket variants, for dif- erent altitudes and weights.

The three variants are called *HR-1, HR-2,* and *HR-3. HR-1* will be capable f attaining an altitude of max. 400 m (250 miles). With a payload of 25 g the altitude will be 310 km. *HR-2* an carry a useful load of 25-115 kg nd attainable altitude is 185 and 115 m respectively. *HR-3* takes between and 15 kg load to 80 and 65 km espectively; with certain modifications t can reach 100 km altitude. The ockets would be fitted with parachutes o salvage the expensive liquid-fuel ocket stages in *HR-1* and *-2* and the seful load with the research instru- nents.

The rockets are fin- and rotation- tabilized with modest acceleration alues—7.5 g for *HR-1/2* and 17 g for *IR-3.*

• **Firings in 12-18 months**—All im- ortant components have already been leveloped within Sweden. Depending n which alternative(s) may be chosen, he time from order to first quantity- roduced rocket would be 18-36 nonths. First firings of prototype rock- ts could be made after 12-18 months. From the viewpoints of cost and time, he *Aurora* project has been based on xisting Swedish rocket engines and ther equipment (developed for mili- ary purposes) including the *VR-3* iquid-fuel rocket developed by Svenska Flygmotor having a thrust of 6000 lbs.

• **Saab is willing**—Saab, according o the Society, would be natural prime contractor for the rockets. Saab's Vice President-Engineering, Lars Brising, has stated that the company is willing to support the program, if the space scientists want Swedish rockets, and to build according to order the rocket body.

Svenska Flygmotor is also very interested in the project, according to its Technical Director, G. Gudmundson. "We have parts for five *VR-3* engines and the design has been tested to complete satisfaction," he said. "Our designers have created a product which due to greater simplicity and lower weight compares well with foreign engines, for instance those used in the British *Black Knight* rocket.

• **Government uncertain**—The Swedish Committee for Space Research cannot at present, however, engage itself in the *Aurora* project for economic reasons, according to its chaiman, Professor Lamek Hulthen. Our economic possibilities are very limited and a project of this size cannot be included in the budget that the research council and FOA (Armed Forces Research Establishment) can finance.

The Royal Swedish Air Board is positive to the project, but cannot yet make any official statement. Nevertheless, the men behind the project have good grounds to expect that the Air Board will provide all possible assistance within the limits of its resources, including making available instruments and ground equipments for the rockets as well as test areas.

A spokesman for the Armed Forces Research Establishment, N. Lundquist, has stated in an interview that the engineers behind the *Aurora* project have done a good job, but that they seem overly optimistic about the possibilities of carrying out the project.

If it is cheaper to buy foreign rockets than to build them at home, Lundquist urges, rockets should be purchased abroad as they will have only civil value. If the rockets are to be used for Swedish space research alone. Lundquist thinks that development cost is too high—particularly

Contribution Cited

THE FRANK M. HAWKS Memorial Award for outstanding contribution to aviation was received recently by Wayne W. Parrish, right, president and publisher of American Aviation Publications, publishers of MISSILES AND ROCKETS Magazine. Left, Earl D. Johnson, president of General Dynamics Corp., and Maj. Gen. Arno Leuhman, director of Office of Information for the Air Force.

since research work of current interest can be carried out with simpler and cheaper rockets.

Interest in Project *Aurora* is great in many quarters, but the problem is financing. To produce fifty *HR-3* rockets and twenty *HR-1* rockets would cost approximately Kr. 4,000,000 ($800,000), including development work.

Luftwaffe Begins Massive Buildup by Buying Mace-B's

The once-mighty Luftwaffe once again will become one of the world's strongest air forces, with the purchase of $120 million worth of U.S. Martin *Mace* missiles.

A descendant of the German V-1 pilotless bomber, the improved *Mace-B* which the Germans will receive will be atomic-tipped, with a range of 1200 nautical miles—about twice that of the "A" model currently deployed with U.S. troops in Europe.

Its warhead is considered twice as devastating as that of the *Thor* IRBM operational with the Royal Air Force. The advanced *Mace* has an inertial guidance system developed by the AC Spark Plug Division of General Motors, a development over the ATRAN (Automatic Terrain Recognition and Navigation) designed by Goodyear Aircraft Corp for *Mace A*.

Present plans for the West German Luftwaffe will make it numerically the largest air force in Europe by the mid-1960's; with acquisition of the *Mace* missile it will have a striking power second only to the U.S. Air Forces in Europe (USAFE).

NATO Will Get Missile Stock Center Now Run by AF

GENEVA—A stock center for missiles has been set up under NATO auspices at Chateauroux, France. As a result of an agreement between the U.S. Army and Air Force, the Army MAP ICP (E), (Military Assistance Program, Inventory Control Point, Europe) has been integrated into the NATO Supply Center, Provisional, as the Directorate of Army Missiles and Rockets.

The Chateauroux facility, currently managed by the USAF, will be turned over to full NATO control in mid-1961. It operates under control of the NATO Maintenance Supply Services Agency in Paris. The NATO Supply Center already stores parts for five types of aircraft used by the NATO Forces and shortly will start stocking components for the NATO lightweight fighter, the Fiat G-91.

soviet affairs . . .

By DR. ALBERT PARRY

Ocean areas as targets . . .

of trial rocket shoots, rather than land areas, will be increasingly favored by Soviet authorities. This was predicted by Professor G. Petrovsky, writing in Moscow's chief military newspaper *Krasnaya Zvezda,* on Jan. 23, in the course of a commentary on the recent successful rocket firing from somewhere in Soviet Asia to a point in the Central Pacific.

The shift from land to sea . . .

will be carried out primarily, Dr. Petrovsky says, to safeguard mankind from the "difficulties and inconveniences" which stem from explosions of rockets aimed at land regions, no matter how scarcely populated. There is less danger to man's life, limb and property if those who launch rockets take the wise measure of "setting aside for their targets such ocean areas as are situated away from the main sea routes and places of fishing, the way it was done by Soviet scientists in the latest experiment" in the Central Pacific. In the age of spaceships, oceans will become main locations of "rocket-dromes," to dispatch and receive interplanetary vessels, Dr. Petrovsky goes on. For surely "there is considerably more of sea and ocean on our planet than there is of land."

Red rocketry is going to sea in earnest . . .

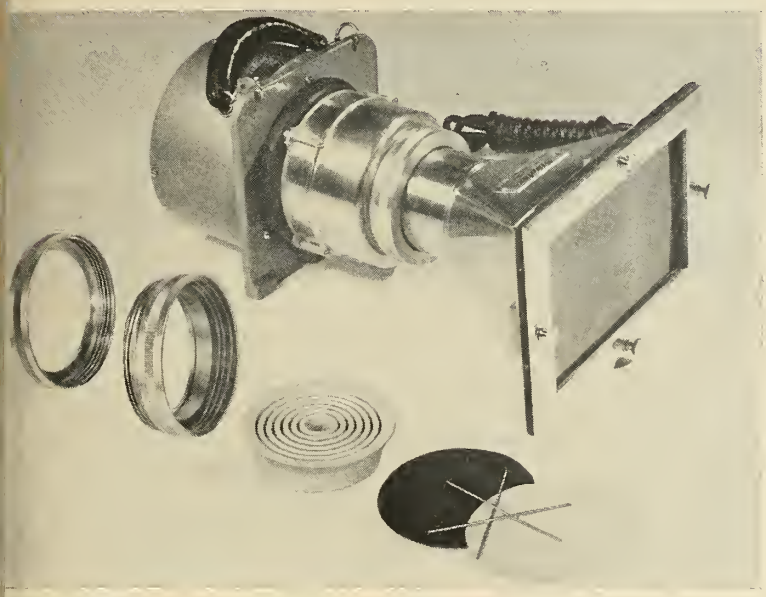
—Such is the frank implication of the statement by Professor Nicholas Varvarov, acting chairman of the Astronautic Section of the USSR's civilian defense organization (DOSAAF). In his article on "The Future of the Earth's Artificial Satellites" in *Komsomolskaya Pravda* of Feb. 2, he writes that long-term weather forecasts are now handicapped by the fact that 70% of our planet is ocean. In a few areas of the Atlantic Ocean weather observations are being made from ships, but hardly any such work is maintained in the Pacific and Indian Oceans. A number of satellites, equipped with meteorological instruments, should be sent aloft to take the needed readings of the air currents and other such phenomena in the upper atmosphere, then relay this precious information to earth-bound meteorologists. "Circling the earth in one and a half to two hours," Dr. Varvarov points out, "they will tell us about the weather over great stretches of territory." He also speaks of the importance of weather-predicting satellites as they derive and relay data while passing over the Arctic and Antarctic ice and waters.

Preliminary "casing" . . .

of the recent Central Pacific target area was done with extreme care. This was revealed in *Krasnaya Zvezda* of Jan. 22 by N. Sysoyev, acting director of the Institute of Oceanology of the Soviet Academy of Sciences. He writes that "one of the basic singularities of the area selected for rocket trials consisted of favorable meteorological conditions." He explains: "Here, in the center of the Pacific Ocean, moderate winds predominate even in winter-time, and hurricanes are rare; whereas in the northern expanse of the Pacific Ocean hurricanes roar incessantly, with winds reaching 30 to 35 miles per second."

This calm in the Central Pacific . . .

is needed, and appreciated, by the special Soviet vessels which "make the necessary soundings in the area of the rockets' fall," Sysoyev emphasizes. He adds that preliminary investigations of this Central Pacific area, southwest of Hawaii, were made by the Soviet oceanographic ship *Vitiaz* in November, 1957 (at the time of *Sputnik II*), and again in February, 1959 (soon after the firing of *Lunik I*). In the first of these expeditions the Soviet probers discovered an important underwater mountain. Sysoyev headed one of the *Vitiaz* expeditions.



Filter Expedites Air Sampling

The Staplex Company has announced that filter holder adapters ranging in size from 6" x 9" to 12" x 12" are now available for its portable, high-volume air sampler. This innovation will enable the machine to collect large samples of the air to be tested in a much shorter length of time, thus expediting the entire operation.

The air sampler is currently being used to measure air-borne particulate matter of all kinds in many diversified fields—especially those concerned with manufacture of missiles and beryllium dust. Compact and portable, the unit can measure particulate matter as small as 1/100th of a micron in diameter both indoors and out. It utilizes a turbine type blower enabling it to draw in large volumes of air in a short space of time.

The sampler is proving extremely useful in the detection and measurement of smoke and smog, air hazards in mines, occupational dusts, and factory health conditions—as well as radioactive particles.

Circle No. 225 on Subscriber Service Card.

Epoxy Molding Compounds

New epoxy molding compounds, hailed as a major breakthrough in rapid, mass production of computer and missile components, have been announced by American-Marietta Co. Adhesives, Resin & Chemical Division.

Known as EMC, the compounds are versatile plastic materials for advanced design and product development. Soft-flow molding characteristics make possible high-speed molding of a host of electronic and electrical parts from materials previously found unworkable in manufacturing processes.

EMC incorporates an outstanding balance of physical, electrical and chemical properties characteristic of epoxies in an easily handled single component system. Other major advantages include low-pressure transfer and compression molding, non-outgassing, self-extinguishing and self-releasing.

In addition, EMC has reduced manufacturing costs to as low as one-sixth of former outlays and offers a high degree of production reliability. The range of current uses runs from molding of miniature electronic parts smaller than a paper clip to the manufacture of giant electrical transformers.

Circle No. 226 on Subscriber Service Card.

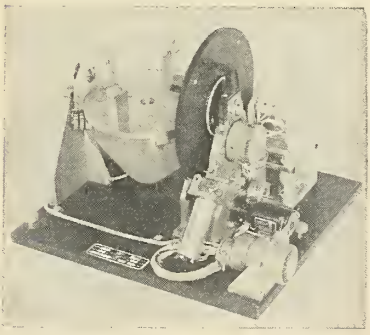
Stimuli Generators

Micro Gee Products, Inc. has announced a new series of inexpensive portable stimuli generating tables for automatic missile, drone, and aerospacecraft checkout. These tables, in conjunction with other ground support equipment, allow most any missile to be "flight tested" on the ground prior to launch by exercising the missile's gyros, accelerometers and other sensors in a precise manner as to attitude, direction and rate.

The model 18A servo table is a voltage-to-angular position platform in two axes for subjecting vertical gyros to angular positions and rate. Operation of the table about one axis tilts the load up to 90 degrees in either direction. The load may be oriented remotely through 90 degrees about a vertical axis allowing the second axis of the gyro to be subjected to the same tests as the first. A constant rate may also be commanded about the tilt axis. The table has a six-inch diameter platform, can handle a four-pound load and can be remotely controlled.

The model 82A rate table consists of a turn platform driven by a synchronous motor. The table may be remotely operated by applying or removing rated voltage. A clutch-brake, when actuated disengages the motor and engages a brake. Platform travel is controlled by limit switches. The table has a six-inch diameter platform and can handle a two-pound load.

The model 90A directional table is



a voltage-to-angular position platform for subjecting directional gyros to angular positions about a vertical axis. Operation of the table, which may be accomplished remotely, displaces it up to 180 degrees in either direction. The table has a six-inch diameter platform and can handle a four-pound load.

Circle No. 227 on Subscriber Service Card.

Electrical Silicone Fluid

An electrical grade silicone fluid combining electrical properties with a low-temperature pour point, is now available from General Electric's Sili-

cone Products Department.

Identified as SF-85 (50), the fluid is designed primarily as a dielectric fluid; however, it may be used as a special lubricant, heat transfer medium, or a mechanical fluid, in a diversity of applications.

The low-temperature pour point of SF-85 (50), below —120°F as determined by A.S.T.M. Method No. D97-47, makes it especially suitable as a dielectric in extremely low-temperature applications. The viscosity of this fluid is 50 centistokes at 25°C (77°F) and SF-85 (50) offers a smaller viscosity change at temperature extremes than conventional silicone fluids. As a result, SF-85 (50) offers application possibilities for airborne equipment subjected to both high and low temperatures.

Circle No. 228 on Subscriber Service Card.

Infrared Transmission Glass

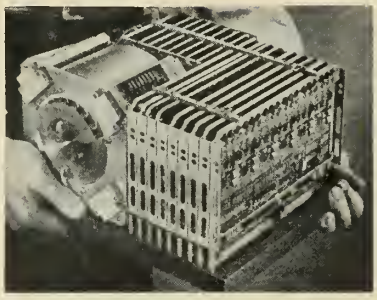
A new glass with improved infrared transmission has been developed by Corning Glass Works for high-performance IR-guided missiles and optical instruments. Dome windows of the glass make it possible for heat-seeking missiles to detect relatively low-temperature targets, according to Corning.

In a thickness of 2 mm, the glass will transmit 77% of the infrared at wavelength of 4.0 microns and 38% at wavelength of 5.5 microns. At 600°C, there is no transmission loss at 4.0 microns; only 13% loss at 5.5 microns.

Circle No. 229 on Subscriber Service Card.

Centaur Digital Computer

A miniaturized, digital computer to be integrated with the *Centaur* guidance system has been developed by Librascope, Inc., under a $1.8-million subcontract.



The Librascope computer will accept inputs from the inertial platform, perform necessary guidance computations, and provide steering signals to the *Centaur* control system. Silcon-transistorized throughout, the digital computer is immune to a wide range of environmental extremes. Weight of the computer has been reduced to 32 pounds, and it occupies only 0.55 cubic feet of precious space inside the missile.

Circle No. 230 on Subscriber Service Card.

Vacuum Electronic Pump

The Ultek Corp. has developed a Series 240 UlteVac High Vacuum Pump applicable to a broad range of uses, from vacuum-tube processing to incorporation into scientific instruments with a 40-liter per second capacity.

Operating on a cold cathode discharge within a magnetic field, the Series 240 has no moving parts and the modular internal structure is easily removed for maintenance or replacement.

Combined with an appropriate power supply, the pump constitutes a complete high-vacuum system—no traps, baffles, nor water connections are required. A roughing vacuum of 15 to 20 microns is required only for starting. After this the system can be sealed off and the Series 240 UlteVac will produce a clean ultimate vacuum below 1 x 10^{-9} mm Hg.

Compact and simple, the pump complete with magnets (as illustrated) weighs 54 lbs, has overall dimensions of 15¼ in. diam. by 7⅜ in. high. One of the mechanical advantages is the compact all-metal coupling (visible on top) having rotatable flanges. This permits any desired orientation of the pump with respect to the remainder of the vacuum system.

Circle No. 231 on Subscriber Service Card.

New Literature

TRANSFORMERS. A 36-page Stancor Transformer catalog is now available from Chicago Standard Transformer Corp. It lists over 750 transformers for industrial, communications and radio and TV applications. Among the new transformers listed for the first time, are a group of high current filament chokes and filament transformers with multiple secondaries. Over 50 transformers for transistor applications with frequency response and impedance characteristic curves are listed. In addition there are numerous other aids for the engineer and serviceman: an output transformer chart for matching output tubes to transformers; exact replacement listings of flyback transformers and yokes; illustrations and descriptions of all transformer types, as well as other helpful data.

Circle No. 200 on Subscriber Service Card.

TUNGSTEN BIBLIOGRAPHY. A complete bibliography on the element tungsten has been made available by Sylvania Electric Products Inc. It includes references appearing in U.S. and foreign publications from 1953 to 1958. Intended for research and development personnel, the book contains 44 pages with 409 references. Each reference includes the name of the author, a brief description of the article and where it appeared. In addition, it contains a subject index, a listing of physical properties of tungsten, and 19 phase diagrams. Price of the bibliography is $1.00.

Circle No. 201 on Subscriber Service Card.

PROPELLANT COMBINATIONS. Performance data for 12 possible rocket propellant combinations—each involving use of concentrated hydrogen peroxide—are set forth in a handy chart just published by Becco Chemical Division of Food Machinery and Chemical Corp. For each fuel combination, the maximum specific im

ılse at sea level, the maximum specific impulse at sea level times the density, the maximum specific impulse in acuum, and the maximum specific mpulse in vacuum times the density, ave been machine-calculated during ıe past year, using the latest thermochemical data available. The 12 cominations for which data are shown re: diborane with 100% hydrogen eroxide, lithium and 99% H_2O_2, hydrogen and 100% H_2O_2, pentaborane nd 100% H_2O_2, lithium and aluminum hydride with 99% H_2O_2, ethyl ecaborane and 100% H_2O_2, lithium ydride and 99% H_2O_2, aluminum-nriched polyethylene and 99% H_2O_2, ydrazine and 100% H_2O_2, UDMH nd 100% H_2O_2, boron trimethyl and 9% H_2O_2, and cyanogen and 100% H_2O_2.

Circle No. 202 on Subscriber Service Card.

ELECTRON MICROSCOPE. An illustrated 6-page folder, describing scientific investigations at Franklin Institute that involve a broad variety of lectron microscope problems, is available from Philips Electronic Instruments. Among the subjects covered: . Study of mechanisms of plastic deormation in metals and alloys using lislocation patterns. 2. Radiation lamage in metals from neutron bomardment. 3. Strength of thin foils. 4. Perfection of evaporated films.

Circle No. 203 on Subscriber Service Card.

STOCK CATALOG. The very latest prices, listings and data are carried in a new issue of Ohmite Manufacturing Company's 32-page, two-color Stock Catalog No. 30A. This is the biggest catalog to date of those items stocked by Ohmite and its distributors for immediate delivery. It lists an increased selection of Ohmite's long-established products as well as some of its newer units.

Circle No. 204 on Subscriber Service Card.

HYDROCARBON DETECTOR. A brochure describing the new Model 213 Hydrocarbon Detector, a completely self-contained portable instrument for rapid measurement of total organically bonded carbons in atmosphere or gases, has been published by the Instrument Division, Perkin-Elmer Corporation. The Hydrocarbon Detector is based upon the flame ionization detector recently developed for gas chromatography. It simply and accurately detects and measures fractions of parts per million of such organic carbon compounds as hydrocarbons, aldehydes, ketones, alcohols, and amines with a sensitivity range adjustable from as low as 0-1 ppm full scale to 10% full scale.

Circle No. 205 on Subscriber Service Card.

WHO READS MISSILES AND ROCKETS?

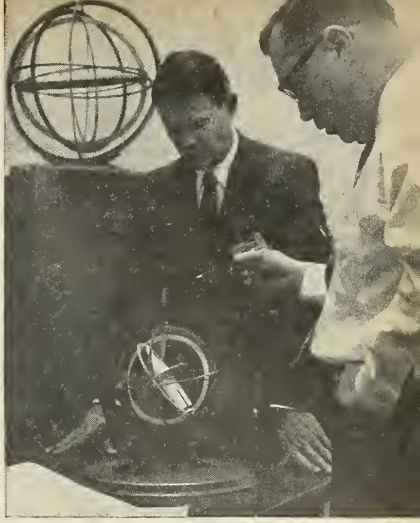
Well, for instance... TOP ENGINEERS OF LOCKHEED

Lockheed has been in the space business for more than forty years exploring, applying, and extending the science of flight almost since its birth. Today the company faces a new frontier — flight in the cosmos beyond the earth's atmosphere. Formed in 1954, Lockheed Missiles and Space Division now employs more than 20,000 people including international specialists in every field of physical science. Its ten facilities comprise 2.5 million square feet of floor space and nearly 5000 acres of land devoted to research, development, manufacturing, and flight testing.

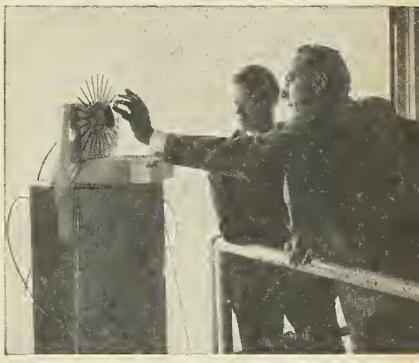
Space travel, whether the vehicle be manned or unmanned, poses vast challenges. Lockheed Missiles and Space Division's approach has been a penetrating and intensive one. In propulsion, guidance, communication, structures, and system management, Lockheed is helping to advance the state of the arts and technologies so vital to free world defense.

Lockheed Missiles and Space Division achievements include some of the most technically advanced products of the space age. Among them are the Polaris ballistic missile, the Agena satellite, the X-17 solid propellant rocket and the Kingfisher target missile. Lockheed's missile and space ac-

"MISSILES AND ROCKETS is one of the top magazines here at Lockheed," says R. P. Della-Vedowa, Manager, Quality Assurance and Test Services, Satellite Systems. "We find its concise technical/news coverage of the missile and space market very valuable in keeping up with developments in this rapidly growing field." In the photograph on the left, Mr. Della-Vedowa (right) discusses the intricate wiring system of the Agena satellite with Clarke Newlon, Executive Editor of Missiles and Rockets magazine.



"Missiles and Rockets presents highly technical information clearly without undue clutter. A very strong selling point because each article is comprehensible to all readers in our field."—J. W. Barnes, Research Specialist, Lockheed's Fleet Ballistic Missile Systems Department.



"I consider Missiles and Rockets an excellent source of information on new advances and applications in the missile/space field. It keeps us abreast of the state of the art in missiles and rockets for a better understanding of advanced requirements in antennas." — A. F. Gaetano, Head, Electromagnetic Systems.

"The weekly issues of M/R give us fresh coverage... not month-old news. Editorially it is well written, sprightly and lively which is a new approach in trade books."— J. L. Shoenhair, Assistant Manager, Polaris Missile Section.

"M/R gives us *what we want* to read in the missile field. There is no waste of time wading through material foreign to our interests." — L. H. Amaya, Manager of Lockheed's Digital Computer Operations.

ties take them deep into the realm of ionic propulsion, gnetohydrodynamics, ultrasonic aerodynamics, nuclear sics, human engineering, electro-magnetism and space munications.

Lockheed, as throughout the entire missile/space industry, R has a deep, penetrating readership and acceptance. At kheed alone, M/R has over 1,000 *paid* subscribers. M/R is only magazine that offers verification of its circulation, stant readership and use in the missile/space market.

YOUR PRODUCT OR CAPABILITY STORY TO 29,000 MISSILE MEN...PAID SUBSCRIBERS...THROUGH AGES OF MISSILES AND ROCKETS—TECHNICAL/NEWS WEEKLY OF THE MISSILE/SPACE MARKET.

missiles and rockets

AN AMERICAN AVIATION PUBLICATION
1001 VERMONT AVENUE, N. W., WASHINGTON 5, D. C.

—contracts—

NAVY

$25,200,000—**Convair, Astronautics Division, General Dynamics Corp., Pomona, Calif.,** for additional production of advanced *Terrier* guided missiles.

$5,914,000—**Ryan Electronics, Division of Ryan Aeronautical Co., San Diego,** for procurement of AN/APN-130 Doppler radar navigation sets, spares, support equipment and engineering support items.

$5,000,000—**Collins Radio Co., Cedar Rapids, Iowa,** for supplying BuShips with additional URC-32 single sideband transceivers.

$4,300,000—**Raytheon Co.,** for extending the range and high-altitude capabilities of the *Sparrow III*.

$2,000,000—**Thiokol Chemical Corp., Denville, N.J.,** for development of a prepackaged liquid rocket engine.

$119,771—**Houdaille Industries Inc., Buffalo Hydraulics Division, Buffalo,** for damper assembly, missile tray.

NASA

Amount undisclosed—**Stromberg-Carlson, San Diego,** for design, construction and installation of the vital monitor and control display system for Project *Mercury*.

$33,500,000—**McDonnell Aircraft Corp.,** for increasing the number of capsules for Project *Mercury* to 20.

$19,000,000—**Air Research and Development Command,** initial NASA funding of a $43-million contract with **Convair** for airframe, stage integration and upper storage tanks of *Centaur*. ARDC is supplying technical support.

$252,000—**Electronic Associates, Inc., Long Branch, N.J.,** for analog computer system to be used in data reduction work in the *X-15* research plane.

$165,000—**Trans-Sonics, Inc., Burlington, Mass.,** for propellant loading system for *Centaur*. (Subcontract from **Convair Astronautics.**)

$29,320—**Heintz Div., Kelsey-Hayes Co., Philadelphia,** for fabrication, machining and assembly of 10 rocket engines.

AIR FORCE

$9,500,000—**Electronic Communications, Inc.,** (a subcontract from **Burroughs Corp.** for work on **ALBI** defense program).

$7,000,000—**Sylvania Electric Products, Inc., Mountain View, Calif.,** for development and production of a ground countermeasures receiving system.

$1,600,000—**Boeing Airplane Co., Wichita, Kan.,** for engineering studies, wind tunnel tests and flight test planning for the *Skybolt*.

$146,079—**Milgo Electronic Corp., Miami,** for radar impact prediction system.

$119,781—**Oklahoma State University, Stillwater,** for research and development of instrumentation for research rockets.

$75,000—**University of Utah, Salt Lake City,** for research and development of circuitry for measurement of upper atmospheric density from rockets.

$59,775—**University of Colorado,** for research and development leading to fabrication, assembly and testing of biaxial pointing controls and associated telemetry problems.

$57,600—**United States Rubber Co., Wayne, N.J.,** for research of nuclear chemistry of short-lived isotopes.

$45,000—**Georgetown University, Washington, D.C.,** for research directed toward refinements of geodetic measurement techniques, utilizing terrestrial and spatial configurations.

$38,315—**Coleman Engineering Co., Torrance, Calif.,** for guidance test sled.

$31,470—**Ampex Data Products Co., Los Angeles,** for recorder for use in support of project *WS-133A*.

$30,164—**Arizona State University, Tempe,** for research on electrical conduction in oxides of some lanthanide rare earth elements.

North Electric Co., Galion, Ohio, for design and manufacture of mobile and fixed electronic communications and switching centers. Subcontract from **General Electric Co.,** amount not disclosed.

ARMY

$20,259,484—**Western Electric Co.,** for improvements on *Nike-Hercules* system.

$12,687,000—**The Martin Co., Orlando,** for continued production, engineering services and ground support equipment for *Lacrosse*. (Two contracts.)

$10,888,178—**Paul Hardemann, Inc., Stanton, Calif.,** for propellant loading systems to be installed at ballistic missile test and operational facilities.

$9,200,000—**Chrysler Corp.,** for continued work on *Jupiter*.

$5,333,673—**Sperry Utah Engineering Laboratory,** for continued R&D on *Sergeant*.

$2,377,848—**Raytheon Co., Waltham, Mass.,** for work on the *Hawk* missile.

$2,024,279—**Minneapolis-Honeywell Regulator Co., Hopkins, Minn.** (classified R&D).

$993,393—**Southern, Waldrip and Harvick Co., Long Beach, Calif.** for construction and installation of fuel storage facilities and a propellant loading system for fueling *Atlas*-boosted space vehicles.

$954,772—**Douglas Aircraft Co., Inc.,** for *Nike-Hercules* missile launching area and adaption kits.

$944,360—**Sperry Utah Engineering Laboratory,** for *Sergeant* missile repair parts and test equipment.

$443,266—**Aerojet-General Corp.,** for research and development.

$300,324—**Hayes Aircraft Co., Birmingham, Ala.,** for work on ground support equipment for *Saturn*.

$236,418—**Cooper Development Corp., Monrovia, Calif.,** for models of passive target high-altitude wind sensing equipment and related items.

$200,000—**Philco Corp., Philadelphia,** for work on *Courier* communications satellite.

$121,169—**Ets-Hokin and Galvan, Wilmington, Calif.,** for off-site utilities for silo launch complex.

$99,485—**Raytheon Co., Waltham, Mass.,** for replenishment repair parts for *Hawk* missile system.

$81,502—**A. J. Diani Construction Co., Inc., Santa Maria, Calif.,** for off-site utilities for silo launch complex at Vandenberg AFB.

$53,646—**Texas Instrument Co., Dallas,** for subcarrier oscillator assembly.

$45,740—**Western Electric Co.,** for *Nike* spare parts and components.

$27,375—**W. M. Lyles Co., Avenal, Calif.,** for off-site utilities for launch site complex at Vandenberg.

$6,937,000—**Raytheon Co., Waltham, Mass.,** for work on the *Hawk* missile.

$64,465—**Consolidated Electronics Corp., Pasadena,** for three oscillographs and one recorder oscillograph.

Southwestern Industrial Electronics Co., Division of Dresser Industries, Inc., Houston, for 240 signal conditioning modules for use on the *Pershing* missile. Subcontract from **The Martin Co.,** amount not disclosed.

MISCELLANEOUS

$60,000—**Electronic Engineering Co. of California, Santa Ana,** for design and construction of data translation equipment.

—reviews—

FEDERAL PATENT POLICY, Key issues in current government studies of patent rights under government contracts, Machinery and Allied Products Institute, and Council for Technological Advancement, 1200 18th St N.W., Washington 6, D.C. 112 pp. $1.50.

The pamphlet consists of three Institute statements addressed to the public congressional hearings inquiring into government procurement patent policy. The present patent problem is outlined, its critical character explained and the nature of the present intragovernment dispute over procurement patent policy treated.

The lines of direct attack being made upon the whole of the existing patent system are identified. The book presents the position of the Institute in regard to these questions but does not make any suggestions as to a course of action. The author's intention is to illuminate the issues involved.

MATERIALS AND TECHNIQUES FOR ELECTRON TUBES. Walter H. Kohl. Reinhold Publishing Corp., New York. 638 pp. $16.50.

This book covers in detail the composition, properties, and behavior of the materials used in vacuum tubes and the techniques for their assembly. It completely revises the author's previous work on the subject (Materials Technology for Electron Tubes), and includes all advances since that time.

The text is written and organized on the basis of replies to a questionnaire sent to users of the previous volume. It covers all the material components of electron tubes and the methods of uniting them—brazing, glass-to-metal sealing, and ceramic-to-metal sealing. Chapters dealing with specific materials contain extensive tabulations of physical characteristics, chemical reactions with various reagents, and processes used in application.

THE AEROSPACE YEAR BOOK (Formerly Aircraft Year Book) Forty-First Annual Edition. Official publication of the Aerospace Industries Association, Inc. Published by American Aviation Publications, Inc., Washington 5, D.C. 478 pp. $10.

This profusely illustrated volume is the standard reference on United States aircraft, missiles and spacecraft.

It includes a complete pictorial review of the outstanding aerospace events of 1959; photographs, specifications, and three-view drawings of aircraft and engines in production, and photographs and status reports on all missiles in operation, production and development.

A summary of the aerospace industry and airline operations during the year and a survey of aviation activities in the Department of Defense, Air Force, Army, Navy, and other government departments and agencies are included.

The Year Book also has a digest of aircraft and missile research and development progress, a chronology of American aviation history and a listing of official records established in the U.S. during 1959.

Dr. William B. Tarpley: Former director of chemical research and development, elected vice president, Chemical Division of Aeroprojects Inc. Prior to joining the firm was chief of applied research, Army Chemical Corps, at Fort Detrick and manager of research, Schering Corp.


TARPLEY

Joseph B. Rice, Jr.: Former director of manufacturing, ElectroData Division, named general manager of Burroughs Corp.'s new ElectroData Manufacturing and Engincering Dlvision.

Nelson C. White, Jr.: Appointed manager of product information for General Electric's Rocket Engine Section. Previously served as a specialist in programing, contracts and marketing research.

Jerome J. Ginsburg: Elected vice president-finance and a member of the board of directors at Tempo Instrument, Inc. Was formerly a partner in the firm of Rosen, Resnick & Ginsburg.

Robert C. Clark: Former buyer for Pratt & Whitney Aircraft Division of United Aircraft Corp., joins Taylor Fibre Co., as a sales engineer in the New England district sales office at Hartford, Conn.

Dr. John J. Bordeaux: Research scientist in electrochemistry and physical chemistry, joins Rheem Semiconductor Corp. as a member of the research and development team.

Previous posts. Senior research scientist in the electrochemistry and solid-state chemistry section of the missile and space division of Lockheed Aircraft Corp.; group leader of researchers studying corrosion for the atomic energy division of Phillips Petroleum Co. and research chemist in the department of metallurgical research, Kaiser Aluminum and Chemical Corp.


BORDEAUX

William F. Hafstrom: Named director of marketing for Autonetics, a division of North America Aviation, Inc., succeeding **Charles A. Wolf,** now operations manager of the division's new Armament and Flight Control product division.

Previous posts: Assistant to the vice president, Bendix Aviation Corp.; marketing manager, electronics division, Stromberg-Carlson Corp.

Frank R. Wallace, Jr.: Formerly manager of materials for Tele-Dynamics, Inc., elected manager-manufacturing at Rese Engineering, Inc.

William T. Caldwell: Former sales manager for Rheem Manufacturing Co.'s Electronics Division, appointed assistant vice president and marketing manager of the contracts administration department of Amelco, Inc.

James E. Glauser: Named director-engineering of Pacific Scientific Co.'s Anaheim facility. Has served the firm's Aero Division in various engineering capacities for more than 15 years.

Ralph R. Stubbe: Appointed engineering manager of C. A. Rypinski Co. Formerly held engineering posts with Standard Coil Products Co., Inc.; Westinghouse, Hazeltine and General Instrument Co., Inc.

Allan Easton: Executive staff member of General Transistor Corp., elected to the board of directors of Efcon, Inc., replacing **Norman Neumann,** recently elected president of General Transistor Corp.


EASTON

Previous posts: vice president-marketing, General Transistor; vice president and general manager, Granco Products, Inc.; chief engineer, Radio Receptor Corp. and Teletone Radio Corp.

Jack G. Anderson: Formerly Hoffman Electronics Corp.'s vice president-marketing, elected vice president-government relations at Stromberg-Carlson division of General Dynamics Corp.

Oscar F. Carlson: Former assistant to the chairman-president of Douglas Aircraft Co., named assistant to the general manager of the Martin Co.'s Denver Division, concerned with overall management and administration of the *Titan* weapon system.

Dr. William L. Whitson: Former vice president-engineering at Daystrom Inc., joins The Martin Co.'s Denver Division as director of advanced programs.

Previous posts: Acting chief scientist at ARPA and assistant director at the Institute for Defense Analyses in Washington, D.C.

Col. Edward N. Hall (USAF, ret.): Appointed assistant to **Perry W. Pratt,** vice president and chief scientist at United Aircraft Corp. Was formerly director of the large rocket development program at the Air Force Western Development division, working on the *Thor* and *Minuteman.*

William C. House: Returns to Aerojet-General Corp. as director-systems management to coordinate the work of the Systems and Space Technology Divisions. Was on a one-year leave-of-absence with ARPA. Formerly directed the Systems Division which developed and produces the second-stage *Able* rocket.

James H. Rowell: Promoted to assistant chief engineer at Phillips Control Corp. Prior to joining the firm was applications engineer with Electric Service Engineering Co.

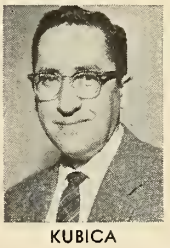
Barney D. Chouinard: Former engineer-designer at Douglas Aircraft Co., joins Precision Instrument Co. as customer service manager.

Dr. A. Charlesby: Appointed senior scientific advisor to Radiation Applications, Inc. Is currently professor of physics at The Royal Military College of Science, Shrivenham, England, and serves as a consultant to the United Kingdom Atomic Energy Authority.

Sydney Shrage and **Andrew J. Kubica:** Join the staff of Power Systems Product Development, Tapco Group, Thompson Ramo Wooldridge, Inc.


SHRAGE

Shrage, named senior project engineer, was formerly a member of the corporate engineering staff at Martin-Baltimore, where he was responsible for space vehicle power systems, including the secondary power system in the *Dyna-Soar* program.


KUBICA

Kubica, who will serve as an engineering specialist, formerly headed the preliminary design group, Special Project Laboratories, Food Machinery & Chemical Corp. He developed reaction control systems for Project *Mercury.*

Dr. Kenneth W. Gardiner: Formerly assistant research chemist, elected chief of Consolidated Electrodynamics Corp., subsidiary of Bell & Howell Co.

Previous posts: Director, General Chemistry Laboratory, Central Research Division, Continental Can Co.; owner and director of Gardiner Instrument Research Laboratory.

—when and where—

MARCH

ASME Gas Turbine Power and Hydraulic Conference, Rice Hotel, Houston, March 6-9.

Society of Instrument Technology, "Data Reduction for Guided Weapon Trials at Aberporth," Manson House, London, March 7.

Heat Transfer Symposium, Mechanical Engineering Dept., University of Florida, Gainesville, March 7-8.

Society for Aircraft Material and Process Engineers, Midwest Chapter Symposium, "Processing Materials for Re-Entry Structures," Miami Hotel, Dayton, Ohio, March 9-10.

Mechanical Properties of Engineering Ceramics, North Carolina State College School of Engineering and Office of Ordnance Research, U.S. Army, N.C. State College Campus, Raleigh, March 9-11.

Institute of the Aeronautical Sciences, National Flight Propulsion Meeting, classified, Cleveland, Ohio, March 10-11.

Electronics Industries Association, Defense Planning Seminar, Statler-Hilton Hotel, Washington, D.C., March 15.

Institute of Radio Electronics, 1960 International Convention, Waldorf-Astoria Hotel and New York Coliseum, New York City, March 21-24.

Ground Support Equipment Conference, American Rocket Society, Statler-Hilton Hotel, Detroit, March 23-25.

Symposium on Optical Spectrometric Measurement of High Temperatures, sponsored by University of Chicago's Applied Science Laboratories; Jarrell-Ash Co.; National Science Foundation, University of Chicago, March 23-25.

22nd Annual American Power Conference, sponsored by Illinois Institute of Technology, American Society of Mechanical Engineering and others, Sherman Hotel, Chicago, March 29-31.

APRIL

University of Connecticut, Sixth Annual Advanced Statistical Quality Control Institute, Storrs, April 3-15.

Solar Energy Symposium, American Society of Mechnical Engineers and Mechanical Engineering Dept., University of Florida, Gainesville, April 4-5.

1960 Nuclear Congress, "What will the future development of nuclear energy demand from engineers?" sponsored by 28 engineering, scientific, management and technical organizations. Includes 6th Nuclear Engineering and Science Conference, 8th NICB Atomic Energy in Industry Conference, 6th International Atomic Exposition, New York City Coliseum, April 4-7.

American Chemical Society, 137th National Meeting, Cleveland, April 5-14.

American Rocket Society, Structural Design of Space Vehicles Conference, Biltmore Hotel, Santa Barbara, Calif., April 6-8.

1960 National Meeting, "Hyper-environments—Space Frontier," Institute of Environmental Sciences, Biltmore Hotel, Los Angeles, April 6-8.

Royal Aeronautical Society, Coventry Branch, "The Optimum Size of Rocket Engines," Coventry, England, April 7.

Society of Instrument Technology, "The Electronic Computer as a Unit in an Automatic Data-Processing System for Missile Trials," Overheu, London, April 7.

ASME-SAM Management Engineering Conference, Statler-Hilton Hotel, New York City, April 7-8.

—Advertiser's Index—

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Let's Be Daring But Not Ridiculous

In these dawning days of the Space Age there is a great need for soaring, unfettered imagination, for daring in vision and boldness in thinking, for enthusiasm.

But enthusiasm and daring alone are not enough. They must be tempered by discriminating judgment as to what is practical, what is possible—and what is idiotic.

One observer has cynically noted that enthusiasm for "blue-sky" research is inversely proportional to knowledge of the problems involved —and directly proportional to the amount of government contract money available.

An executive of a great U.S. missile manufacturer has this framed admonition on the wall of his office:

"The technical axiom that nothing is impossible sinisterly conditions one to the pitfall corollary that nothing is ridiculous."

There is little question that many dollars have been spent on far-fetched ideas that have no basis in practicality or even in possibility. By the same token, contractor management has often sold gold-plated R & D projects to the military knowing them to be without merit and certainly unworthy of their own company-supported financing. To many, the government appears as a benevolent grandfather bestowing largesse on a favored few.

Complicating the problem is the fact that many in the military are not really competent to judge the merit of these rosy promises hard-sold by reputable companies. This is no reflection on the abilities of the buyer. He just cannot be as technically up-to-date as the men who have researched pet ideas in laboratories for years. Somewhere along the line, the buyer must accept the word of a man who should know.

A further complication is that in our mad pursuit of progress we're afraid of overlooking a good bet. Whether it's a death ray, control of the weather, changing the earth's magetic field, or nullifying gravity—hope for a solution to our problems of defense and maintenance of the peace often leads to indiscriminate spending of money on elusive and impractical goals.

This is not to say that blue-sky research should be stopped. What appears "far-out" today may be possible—and urgently necessary—tomorrow. Worthwhile ideas must be explored if we are to survive.

The problem places a burden on both the military and industry. Our defense program must have realistic goals and lines of progress. Any proposed projects outside the accepted guide lines should be viewed with fine discrimination. Decisions must be based on technical judgment and logical extrapolations—not wishful thinking.

The greater burden falls on industry. Not only technical judgment, but moral obligation must be considered in determining the merit of a project. The decisive factor should be whether the manufacturer thinks an idea merits investment of his own money—with a fair chance of profitable return. Industry must be objective and unselfish.

Clarke Newlon

Paradoxes of Power

The American tourist in Russia who cried out in the lobby of the Hotel Ukrainia, "These people can't even get me a ticket to Odessa! How can anyone suppose that they could send a rocket to the moon?" misconstrues the situation. He innocently supposes that service to the consumer is the ultimate test of economic and administrative efficiency. Khrushchev operates under no such illusion.

The Soviet leadership thinks it important to send a rocket to the moon and not very important to supply tourists with tickets to Odessa, so they apportion their talent and resources accordingly. The able men work on rockets, the dopes on tickets.

Our own beloved country meanders along on the opposite theory: we allow the market to determine our national priorities, which means that we allocate a major share of our talent and resources to consumer services and too often leave the sending of rockets to the moon to men who might be better employed selling tickets to Odessa.

Reprinted from Encounter Magazine—*Arthur Schlesinger, Jr.*

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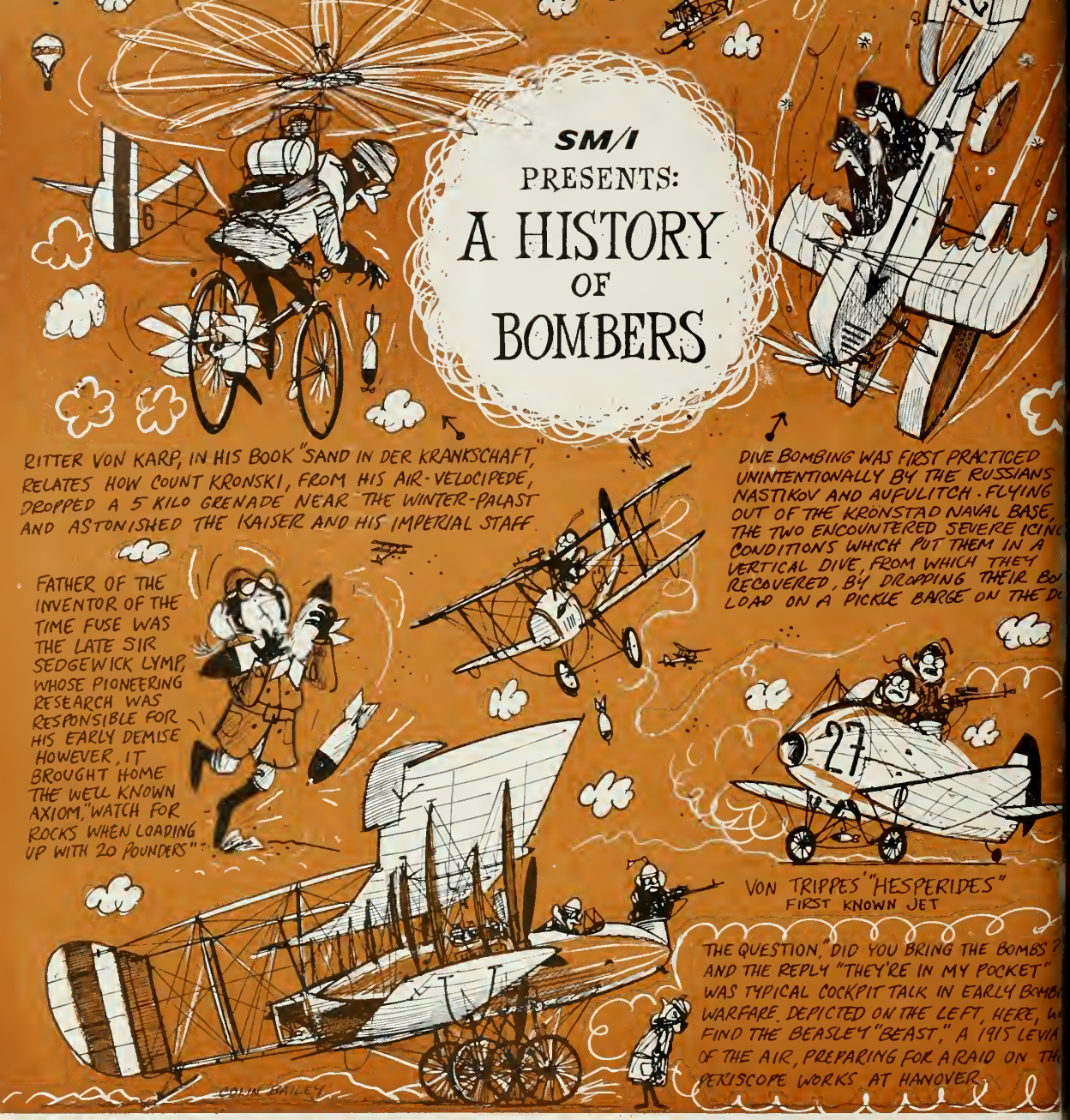

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